POWER

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Better Relations

Of the evident obstacles to satisfactory relations between buyer and seller, none is more deplorable than mutual distrust. More often than not this is helped by the seller's certainty that he is expected to jump through the hoop when the purchasing "ringmaster" cracks the whip. Or, perhaps, the buyer looks upon the salesman as a smart old stager who may yet be induced to undersell his own product if he is "handled" properly.

Transactions under this atmosphere usually end in a horse-trading marathon in which all sense of buying and selling ethics is lost, or at least temporarily obscured, by the smoke of battle. But in the meantime an almost irreparable damage has been done.

The successful bidder has sold himself into the red and has made it harder for his competitors and himself to get a fair price on the next job.

In addition, the purchaser's loss of prestige among high-class manufacturers has laid the groundwork for an indifference to his needs that may prove expensive to his company in the long run.

There is a way for buyers and sellers to build confidence in each other—but that is not it.

EDITORIALS

Economics and Rate Making

From time to time public-spirited organizations have had open forums on the so-called "power issue," and it is interesting to observe the changes in attitude toward various phases of the subject as evidenced by opinions expressed at these meetings. While the general topic usually remains the same—"Public Control of Power" or "Power and the Public"—the angle of approach goes through a progressive evolution.

At the sessions of the Academy of Political Science in New York, last year, speakers on both sides of the question placed major emphasis on valuation. Exponents of "prudent investment," "present value" and other theories of evaluating utility property for rate-making purposes proclaimed that justice to consumer and producer alike depended mainly on the adoption of one or another of these methods.

At the meeting of the Academy held a week ago in Philadelphia "valuation" was in the background and the speakers belittled its importance.

Instead, this year's discussion showed a growing tendency on the part of both public and power company representatives to attack the problem on its economic merits. Practical considerations of load shift and growth, the business value of the lowest possible rates and the advantages of sound, unwatered financing received principal attention.

This new attitude is significant, and encourages the hope that the power issue may be progressively decided on logical economic grounds.

St. Lawrence Developments

Apparently Governor Roosevelt of New York State and Chairman Walsh of the Power Authority are acquiring a working knowledge of the difficulties of getting work started on the international section of the St. Lawrence River. Shortly after the Power Authority was created, this year, the Governor and Mr. Walsh made a tour of the St. Lawrence waterway and reported possibilities of actual construction work being started in the late fall or early winter. This period is close at hand and reports from Washington indicate treaty negotiations have not been started.

Canada has expressed her willingness to negotiate a treaty with the United States through diplomatic channels. Consent by the United States Government was scarcely given to this suggestion when Chairman Walsh of the Power Authority requested that an agreement be entered into between New York State and the Federal Government as the basis for a treaty with Canada. This, Secretary of State Stimson has politely refused to do, although recognizing New York State's paramount interest in power development.

To complicate the problem further Premier Taschereau of Quebec has expressed opposition to Canada's spending millions to assist the United States to exploit millions of horsepower on the St. Lawrence.

These new phases of the problem threaten even greater delays than could have been anticipated a few months ago.

The Combustion Specialist

While many young engineers are giving serious thought to the possibilities offered for a career in the power field, their attention should be directed to the opportunities in certain special branches of that field. Some engineers have become outstanding as authorities on water treatment for boiler feed; others have become specialists in metals; and still others have devoted their best thought to the characteristics and applications of refractories. Specialization in the combustion of fuels and its associated problems offers a further field of useful endeavor.

Maintenance of high station efficiency is largely dependent upon the performance of the boiler room, through close control of combustion and of heat absorption after combustion. This is the distinct field of the combustion specialist and he is needed in every large plant. Smaller plants may use his services collectively.

What are the necessary qualifications of such a specialist? In the first place, he should have made a special study of the combustion of fuels. He must learn the characteristics of all fuels that may come within his sphere of work. He should be adept at calculation of combustion processes, should know the physical and chemical actions of gases at high temperatures and should acquaint himself with the latest developments in the theory of radiant energy and its transfer.

Ash is the cause of many difficulties. What can be done to overcome these? How may ash be most cheaply handled and commercially sold? What devices will reduce ash and dust discharges from stacks? All these are special problems for the combustion engineer. But his principal problem will be the maintenance of high boiler efficiency. He must know what devices are used to insure this result. Control equipment is often delicate and requires close attention to be most effective. The specialist must be able to scout troubles at the controls and correct these when they occur.

There is a wide and diverse field open to one specializing as a combustion engineer. Those in charge of central stations already recognize the value of such men and they are slowly but surely gaining recognition in the industrial power field.

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POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

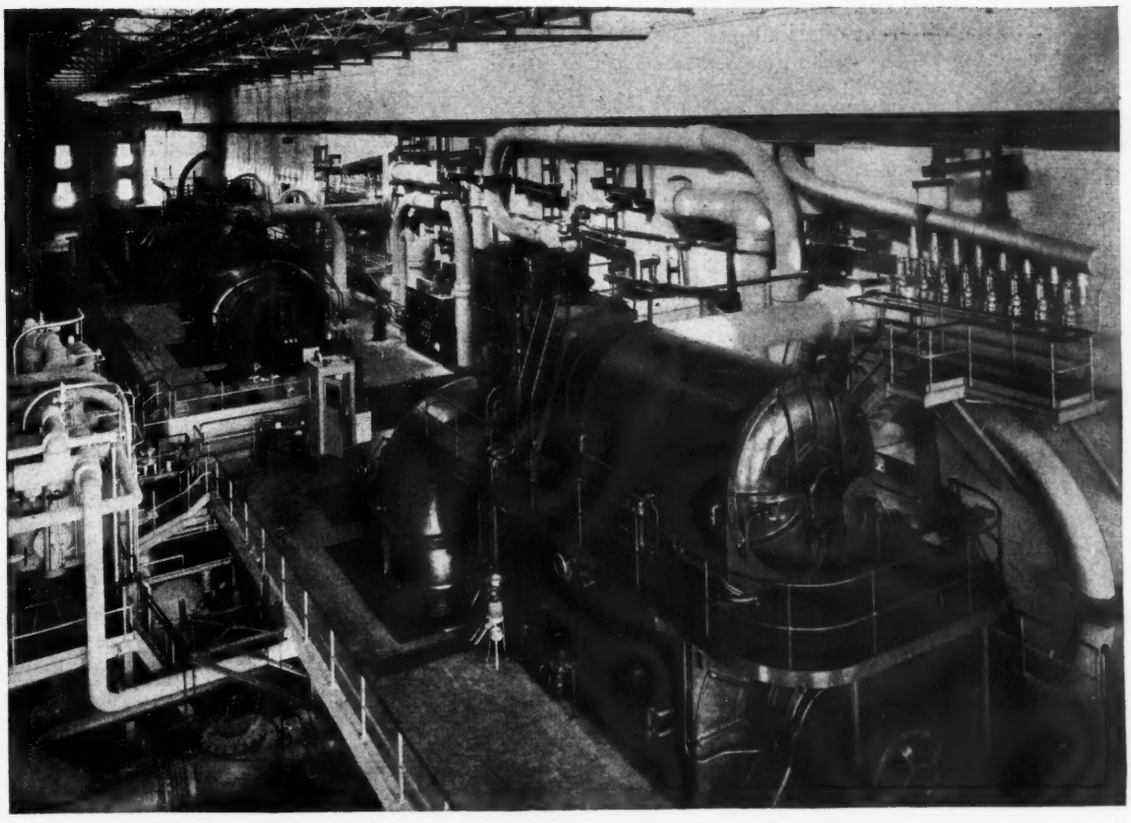

Fig. 1—These two 50,000 kva. vertical-compound turbine-generators occupy the space formerly taken up by two engine-driven units and two vertical turbines

Operating Features of Station A

By C. E. STEINBECK
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The first unit of the Pacific Gas & Electric Company's Station A, 1,400 lb. steam plant, at San Francisco, went into operation the first part of February, 1931, and the second unit in June. Articles have been published in the technical press describing the principal equipment in this station, giving the station's history and describing its relationship to the company's hydro-electric system. Only a brief summary will be given here with the idea of providing background for the detailed operating procedure described

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STATION A was built originally by the Independent Light & Power Company in 1901 and was the last word in that day in power plant design. By the end of 1905 the station was completed to a capacity of 18,000 kw., the installation consisting of ten engine-driven generators ranging from 500 to 3,500 kw. in capacity. In 1910 the second period of its history commenced with the removal of some of the engines and the installation of a 12,000-kw. vertical steam turbine. By 1918 all the engines except two of 3,500-kw. capacity each had been removed and two more vertical and one horizontal turbines had been installed in the same space, bringing the station capacity to 57,000 kw. exclusive of the two 3,500-kw. engines. In the first installation the boilers were for 200 lb. pressure without superheat. With the advent of the turbines the same boilers were used and superheaters added giving 100 deg. F. superheat. Additional boilers were added from time to time as needed.

There are several reasons why decision was made to rebuild Station A. In the first place, its central location as a distribution point for power in San Francisco was

ideal. Very little change was necessary in the outgoing feeders to the different distribution substations or to the feeders leading to the substation at the end of the high-tension transmission lines feeding the city from the hydro-electric plants. With this latter connection it was possible to feed power back to the high-tension transmission system in case of trouble or hydro-electric power shortage.

The salt-water circulating system for the station was already developed and required little change. Although the existing buildings limited the number of ways the apparatus could be arranged, the final arrangement has proved satisfactory. The selection of the vertical-compound type of turbine resulted in the saving of space and foundation costs.

Estimates of costs per kilowatt of the 1,400-lb. plant compared with 450 lb. showed the former to be no higher, and actual costs have proved the 1,400-lb. plant to be lower.

The present high-pressure installation in the turbine room has been made by the removal of the two old engines and two of the vertical turbines. When the station is completed to its ultimate capacity of 260,000 kw. the space occupied will be actually less than that occupied by the original 18,000 kw. of engines. The only changes that have been made in the turbine room have been to add a new crane of 100 tons' capacity and change the crane rail to suit, underpin the building walls, which are made of brick, and replace the old corrugated-iron roof with a corrugated-transite roof.

The boiler room contained thirty boilers when the present reconstruction commenced. Fifteen of these were removed and three high-pressure boilers added. In the ultimate station a total of five high-pressure boilers will be used. These will occupy much less space than was occupied by the thirty boilers installed when this reconstruction work began. Two 350-lb. boilers, installed in 1924, are being retained for auxiliary steam stand-by and will be used in the ultimate station for supplying steam to a house turbine. The changes to the boiler room consist of the addition of a fan room above the old boiler room. The fan room is supported on the boiler steel, which is all inside the original brick walls of the old boiler room. A small amount of underpinning was installed under the boiler room walls.

The high-pressure turbine units are of the vertical-compound type, the high-pressure turbine and generator being supported over the generator of the low-pressure unit. The units have been operated at 62,000 kw. with No. 1 heater in and 68,000 kw. with this heater out. Fig. 1 is a view of the two turbines. There are three boilers installed, of the cross-drum type, two having reheaters, economizers, and air heaters, and the third having economizer and air heater only. One boiler could not furnish enough high-pressure steam for a unit at full load, so the third boiler was added to make up this

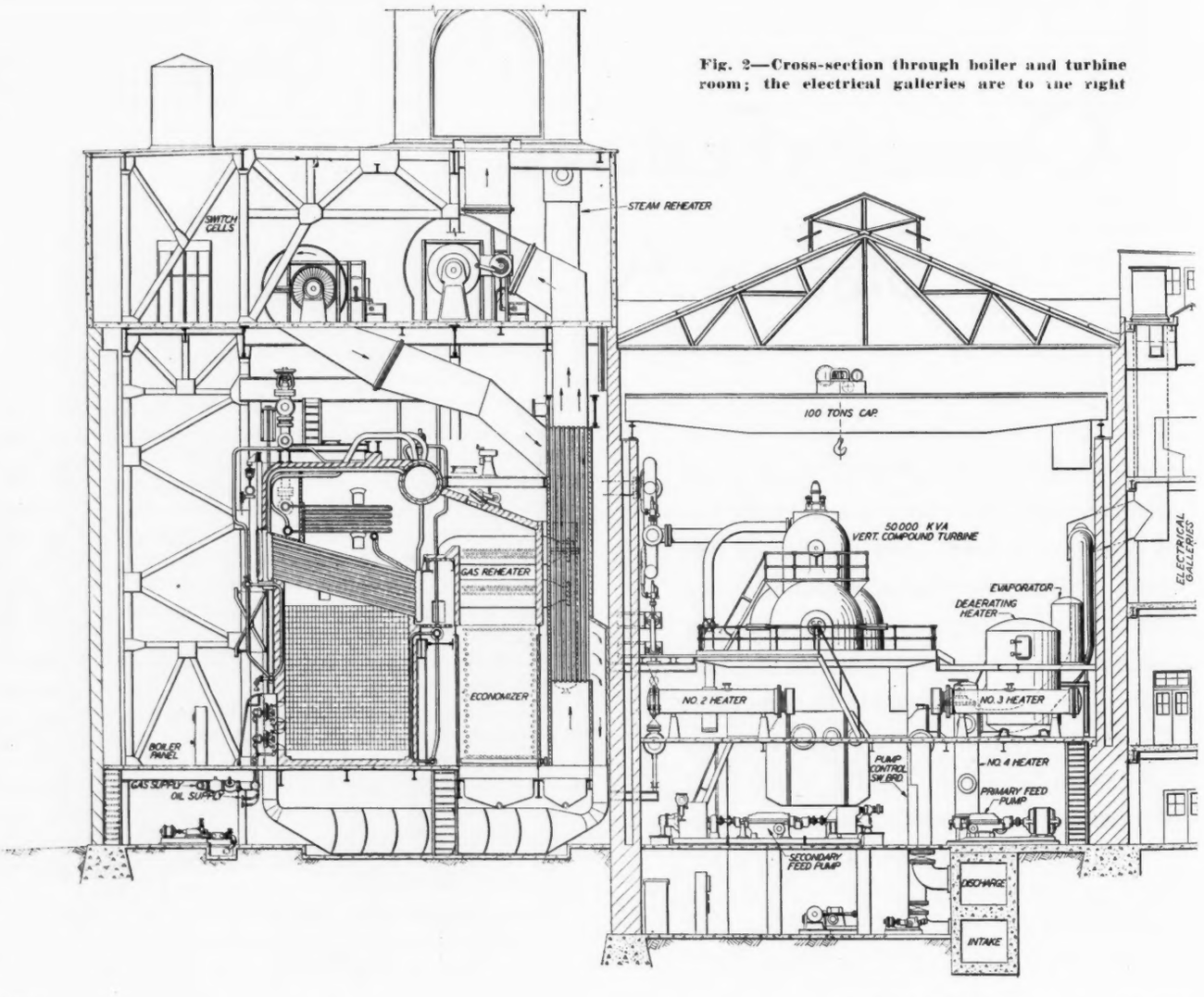


Fig. 2—Cross-section through boiler and turbine room; the electrical galleries are to the right

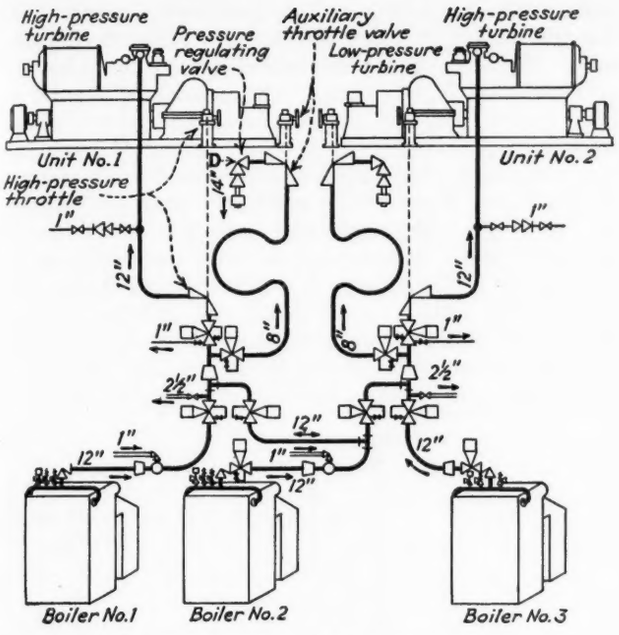


Fig. 3—Diagram of high-pressure piping

amount and to act as a spare. The turbines require 575,000 lb. of 750-deg. steam per hour for full load, and the boilers were designed for 500,000 lb. per hr. each. The two reheat boilers, however, each have sufficient reheat surface so that one boiler will reheat all the steam coming to it from a turbine to 750 deg. However, in order to flatten the reheat curve at light load, a steam reheater using saturated 1,400-lb. steam as the heating medium is installed in series with the flue gas reheater.

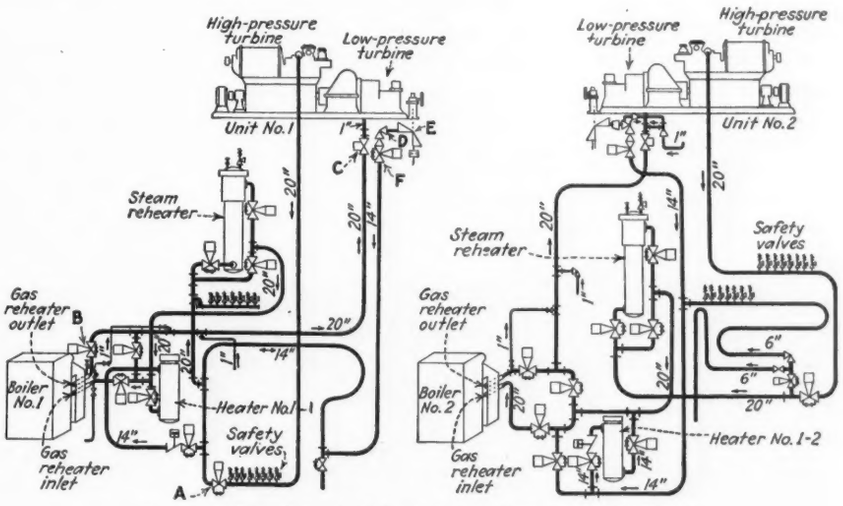
Fig. 3 is a diagram of the high-pressure piping between the three boilers and the high-pressure turbines, while Figs. 4 and 5 show the arrangement of the reheat steam piping between the turbines and the boilers. These diagrams have been drawn separately to do away with the complication of trying to put too much on one drawing. Boiler No. 1 is the reheat boiler for turbine No. 1 and boiler No. 2 is the reheat boiler for turbine No. 2. Boiler No. 3 is used both to make up the additional steam required to operate the turbines at full load and also as a spare in case either of the reheat boilers is out of service. Under normal operation, with both turbines running at full load and all three boilers in service, the steam flows through the 12-in. lines to the high-pressure turbines and the load is so balanced between the boilers that the temperature of the reheated steam is maintained at 750 deg. at each reheat boiler outlet.

The control panels for boilers Nos. 1 and 2 are in front of boiler No. 2. This panel is shown in Fig. 6. The control panel for boiler No. 3 is in front of boiler No. 3, and the master panel and other panels upon which are mounted instruments used for records and for other purposes not considered necessary for constant observation are in front of boiler No. 1. At present one fireman is on duty in front of each control panel.

Referring to Fig. 4, it will be noted that the exhaust from the high-pressure turbine flows through a 20-in. line to the bottom of the steam reheater, which is set vertically above, and to the side of, boiler No. 1, then out the top to the inlet of the flue-gas reheater in the boiler, and then to the inlet of the low-pressure turbine. The high-pressure turbine casing is protected against the closing of any valves in the line between it and the low-pressure turbine by a battery of safety valves indicated on the line between the high-pressure turbine and the first valve. Heating steam for the reheater is taken from the boiler drum at saturated temperature due 1,400-lb. pressure. This steam enters at the top of the steam reheater as indicated in Fig. 7, and, after being condensed by the steam to be reheated, the condensate is returned by gravity to the boiler drum.

Satisfactory control is obtained by operating the 20-in. inlet and the 14-in. bypass valve on the reheat lines at the steam reheater, Figs. 4 and 5. For instance, if both valves are open and it is desired to obtain more reheat the 14-in. valve is closed gradually until all the steam is passing through the steam reheater. Likewise, if it is desired to obtain less reheat the 20-in. inlet valve is gradually closed until all the steam to the reheater is bypassed. An electrical reheat temperature indicator, brought down to the boiler operating panel with the temperature element placed in the piping at the gas reheater outlet, gives the fireman the necessary information for operating the 14- and 20-in. valves. These valves are controlled by push-button at present, but plans are under way to adapt them to automatic operation.

The steam reheater has been found to be of additional advantage in the operation of the reheat boilers in that when taking the boiler out of service after the fires have been removed and the turbine is being operated with steam from the standard boiler, by passing the high-pressure exhaust steam through the steam reheater enough steam is drawn from boiler drum and heat transferred to the exhaust steam so that the time of cooling down the boiler has been cut approximately in half. It takes about 24 hr. to cool a reheat boiler down with this method. After removing the fires from one of these high-pressure boilers there is enough heat stored to operate the turbine at 5,000 kw. for about fifteen minutes if the steam reheater is not in use.



Figs. 4 and 5—Reheat piping between boilers and turbines

The turbine units have been designed to operate compound normally, or the low-pressure turbine may be operated separately if the high-pressure turbine is out.

In bringing the reheat boiler up to pressure, provision

is made for maintaining circulation to keep the superheater and flue-gas reheater from becoming overheated, by passing the steam generated, as the boiler pressure rises, through the superheater; and by means of the superheater drains, Fig. 8, part of this steam is taken to the flue-gas steam reheater. After passing through the reheater, which has its outlet valve closed, the steam is then drained to atmosphere. Electrical thermometers are used to determine the amount of cooling steam necessary.

When the boiler pressure has reached about 550 lb. the 20-in. line between the flue-gas reheater and the intercepting valve is warmed by the use of a 1-in. line, shown on Figs. 4 and 5. This takes but a few moments. When the pressure in this line reaches between 25 and 50 lb. the high-pressure turbine exhaust stop valve and the reheater outlet valve are opened. With the intercepting valve closed vacuum is obtained in the low-pressure turbine in the usual way. Maintaining 50 lb. pressure in the high-pressure turbine exhaust piping, the reheater and the piping from the reheater to the intercepting valve precludes the necessity of having to maintain vacuum in all this piping and equipment, which would be the case if the intercepting valve were not kept closed.

Starting the Turbine Unit

In starting the units steam is admitted to the high-pressure turbine, and, as it starts to revolve, the generator of the high-pressure unit motors the generator of the low-pressure unit and this element starts in motion also, since these generators are interconnected electrically. As the low-pressure element starts to revolve and steam from the high-pressure turbine exhaust reaches the intercepting valve, pressure builds up. The intercepting valve is then opened by a handwheel and 50 lb. is still maintained ahead of it. The usual methods are used in bringing the turbines up to speed. As soon as the low-pressure turbine reaches 1,500 r.p.m. the intercepting valve is opened wide. As normal speed of 3,600 r.p.m. on the high-pressure turbine and 1,800 r.p.m. on the low-pressure turbine is reached and usual checks are made the unit is synchronized and given a load of 5,000 kw., which is carried as a minimum on these units. It usually requires about 1½ to 2 hr. to put one of the units on the line. The high-pressure turbine is the governing turbine in compound operation.

In starting at 550 lb. pressure and bringing both boiler and turbine up together, it is possible to secure water for the boilers by using the primary boiler feed pumps only. These are motor-driven and operate up to between 600 and 700 lb. pressure. The secondary pumps are bypassed at first, and consequently there is no difficulty in supplying sufficient feed water to the boilers. The secondary boiler-feed pumps are driven by two turbines, one operating from 350-lb. auxiliary steam and exhausting into the main condenser and the other turbine operating from exhaust steam from the high-pressure turbine and exhausting to No. 2 feed-water heater. As soon as the turbine is revolving and sufficient vacuum is maintained in the main condenser the secondary pump may be started with the condensing turbine and put in series with the primary boiler-feed pump and water at

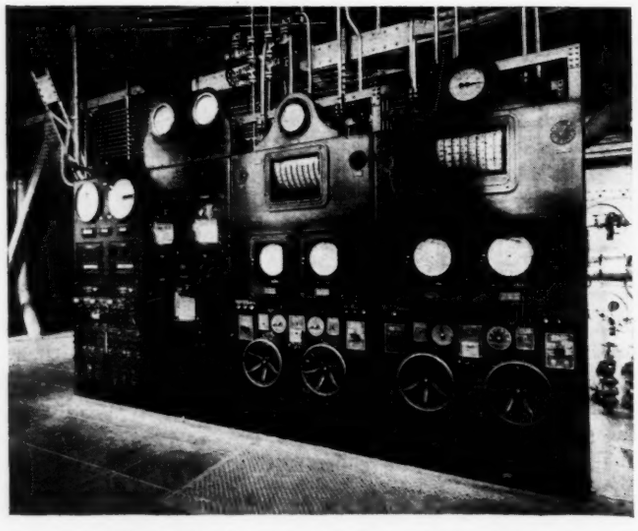


Fig. 6—Control panel for boilers No. 1 and 2

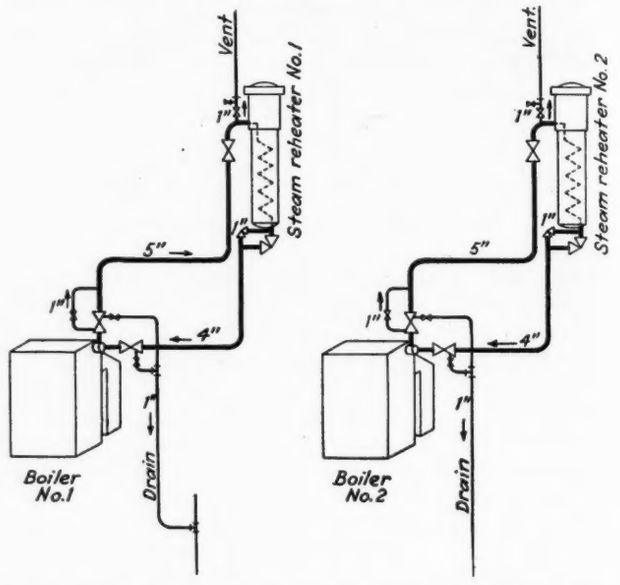


Fig. 7—Diagram of piping for heating steam to steam re-heater

sufficient pressure obtained to operate the boilers up to their designed pressure of 1,400 pounds.

If the high-pressure turbine is out of service and it is desired to operate, using the reheat boiler, the high-pressure turbine exhaust valve *A*, Fig. 4, is, of course, closed and valves *B* and *C* are closed as for compound operation. Valve *F* is also closed. The boiler is brought up to 550 lb. pressure and the 20-in. high-pressure turbine exhaust piping to between 25 and 50 lb. as before. High-pressure steam is now taken through the 8-in. line (Fig. 3) up to the live steam throttle valve *E* and live steam control and reducing valve *D* as shown in Fig. 4. Valves *B* and *F*, Fig. 4, are now opened. Live-steam throttle valve *E* is now opened sufficiently to maintain 150 lb. up to the intercepting valve. By handwheel control, this valve is opened sufficiently to start the low-pressure turbine to revolve, after which this valve is again closed. After the usual starting inspection is made, and before the turbine comes to rest the intercepting valve is opened sufficiently to maintain 50 lb. ahead of it, at the same time keeping the turbine speed at 400 r.p.m. The turbine is then brought up to speed and put on the line as before. Under this condition of operation the live steam control valve is under control of the low-pressure turbine governor.

It was intended, when using the reheat boiler for this type of operation, to desuperheat the steam by passing it first through No. 1 feed-water heater; but this has not worked out with entire satisfaction, because of mechan-

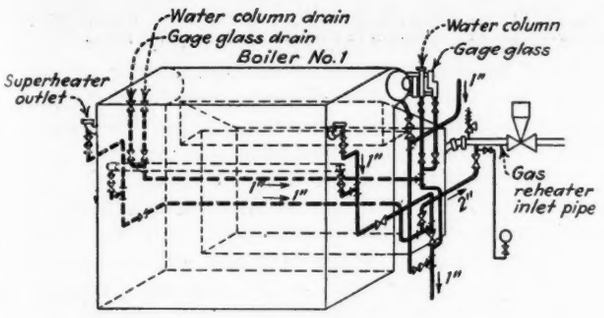


Fig. 8—Arrangement of superheater drains

ical troubles. Corrections are being made, and should occasion arise for this type of operation it will be again attempted. With No. 1 feed-water heater out and the steam reheater bypassed, only 15,000 kw. can be obtained without excessive reheat temperatures.

By operating the low-pressure turbine with steam from the standard boiler only a 36,000-kw. load may be carried. This method of operation is not efficient, due to the lower superheat obtained by passing the 1,250-lb. 750-deg. steam through the reducing valve. The best method for low-pressure operation in which it is possible to carry a load 50,000 kw. is by taking steam from the standard and a reheat boiler. The steam flow between the two boilers can be so adjusted that after passing through the reducing valve and going to the reheat boiler the proper reheat temperature will be maintained.

Fig. 9 illustrates the major part of the feed-water system. The condensate pump discharge is taken through the jet condenser and the fourteen-stage heater and discharged into the deaërating heater. This is not shown. The piping arrangement from there on to the boilers is shown and needs no further description.

The primary pumps are motor-driven by 600-hp. constant-speed motors, and one spare is arranged for use for the two turbines. Two of the secondary pumps are provided with a turbine on each end as illustrated. One of these turbines on each pump operates condensing and discharges into the main condenser and is furnished with 350-lb. steam from the auxiliary steam supply. The other turbine is driven by steam from the exhaust of the high-pressure turbine. Either turbine is large enough to drive the secondary pump at full load, about 1,200 hp. being required. The second turbine exhausts into No. 2 feed-water heater and operates with an open throttle, so that the amount of load that this turbine carries is dependent upon the pressure and temperature of the steam in the high-pressure turbine exhaust and the temperature and flow of water through No. 2 feed-water heater. At maximum load this turbine carries most of the load. The condensing turbine acts as the governing turbine for the unit, and by automatic control constant water pressure is maintained in the secondary pump discharge header. Protection is given these pumps in case of failure of water supply by solenoids which trip both turbine throttles if the primary pump discharge falls below a predetermined amount. This method of control works with entire satisfaction.

Automatic control of the feed water to the individual boilers is obtained by a three-element control on each boiler. The three elements entering into this control are water flow to the boiler, steam flow from the boiler and water level in the drum, the object being to control the drum water level to a given position, that is, 7 in. below the center line of the drum at minimum loads and 3 in. below at maximum loads. This control has worked with entire satisfaction and maintains the water level no matter how much the load swings on the boilers; in fact, the water level is controlled so well that although a boiler has lost full load the variation in water level has maintained the 4-in. range indicated. The feed-water control valves are on the inlet line to each boiler. These valves are placed in series and are operated automatically or may be operated by Selsyn hand control from the boiler-operating panelboard or manually at the valve. Normally they both operate together, but they are so designed that should the motor drive of one fail it will remain fixed in the position in which it was when failure occurred and may be opened by hand and the other valve will do all the controlling. Normally, with both valves in operation, by placing them in series the pressure drop through each valve will be less than if one valve were doing all the controlling, and consequently possible wear on the seats and disks is kept to a minimum. As an additional protection for the feed-water control a stop valve ahead of these two control valves will be motor-operated and controlled from the boiler-operating panel.

Natural gas is burned as fuel, at the present time about 27,000,000 cu.ft. per day being used for the three high-pressure boilers when the station is under full load. Combination natural gas and mechanical fuel oil burners are installed, fuel oil being available as stand-by in case of failure of the natural-gas supply.

Each boiler has one forced- and one induced-draft fan of adjustable-inlet-vane type. Each fan is driven at two speeds.

When operating all three boilers the usual practice is

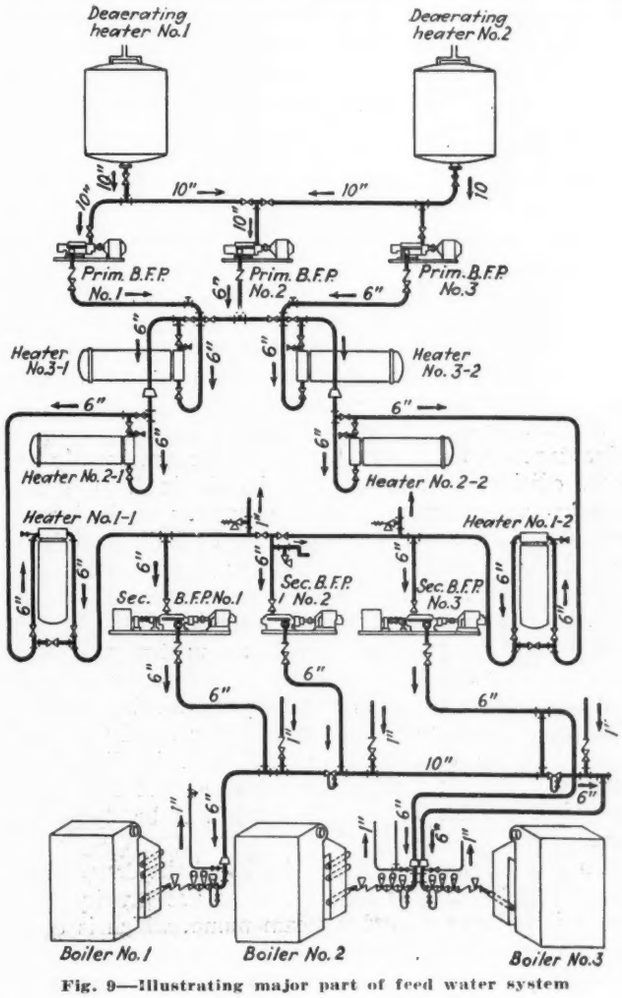


Fig. 9—Illustrating major part of feed water system

to set the two reheat boilers on push-button control so that fuel, forced- and induced-draft fans and water level are all controlled by this means, and then place the standard boiler on full automatics, so that this boiler will take all the load swings.

From experience to date, it is felt that the operation of a 1,400-lb. plant is no more difficult than a modern low-pressure plant. Performance under 12,000 B.t.u. per net kilowatt-hour has been obtained, and future major installations of steam will be made by more 1,400-lb. stations.

The engineering department of the Pacific Gas & Electric Company, of which A. H. Markwart is vice-president in charge, engineered all the reconstruction at Station A. The division of electric distribution and steam engineering, of which S. J. Lisberger is chief engineer, has had supervision of all the design, with R. C. Powell, assistant chief and mechanical engineer, in direct charge. This company's construction forces, under the supervision of O. W. Peterson, construction engineer, with M. C. McKay in direct charge of work, have been responsible for the construction.

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Some Pointers on Burning Fuel Oil

By R. H. PARRISH

IN AN oil-burning system either spray or mechanical atomizing burners may be used. The simplicity of the steam atomizing burner makes it preferable in many cases where the loss of steam and the consequent requirement of an equal amount of boiler make-up water is not objectionable. With a good type of burner, the steam required for atomization is less than 2 per cent of the total generated, with the boiler running at its rated capacity. This percentage will decrease with increase in boiler rating. The amount of steam required by mechanical burners for heating and pumping is in the neighborhood of ¼ of 1 per cent of the total generated, and the condensate can be returned to the system. It is this fact that makes a mechanical atomizing burner desirable for marine or other work where conservation of feed water is important.

Regardless of the type of burner, heating the oil is advantageous, as it may be atomized more readily and more efficient combustion may be obtained. Oil temperature and pressure affect the capacity of the burner, and provide a means of regulation of individual burners. Large variation in demand for steam is taken care of by putting additional burners into service.

It is important that the oil be supplied to the burners under constant pressure. With an unsteady pressure of oil, either the flame is likely to go out or more oil will flow through the burner than can be properly atomized. Smoky combustion will result and the boiler tubes will be covered with soot that is difficult to remove. The oil that is not atomized will be wasted, and if it collects in the pit, there will be danger of explosion.

To guard against wastage of oil and the danger incident to leakage, it is inadvisable to use gravity feed. For this purpose a duplex steam pump, which is easily governed and is capable of producing a steady oil pressure, is preferable. Another advantage is that when the plant is shut down, the accidental opening of a valve will not result in a waste of oil.

When making an installation, the burner should be placed horizontally at a distance from the shell equal to one-half the shell diameter. The firebricks are arranged to admit and distribute the air over as wide an area as possible. A large combustion chamber unobstructed, with the exception of a checkered brick target, results in good combustion. Air for combustion enters through the ashpit and can be controlled either by the ashpit door or by both ashpit door and damper. It is best to regulate by the damper, leaving the ashpit door open.

Regulators operated by steam and oil pressure are obtainable for automatically regulating the supply of oil and steam to the furnace. Often a slight change in air supply is sufficient to make a remarkable difference in the results, so that it is well to have a damper that can be locked in any desired position. Even though the average operator has the ability to construct certain pieces of the required apparatus, including pumps, oil burners, oil heaters, strainers, regulating valves and fittings, where experience is lacking it is always safer and more economical to buy standard equipment.

Fuel oil is delivered in tank cars and generally stored in underground tanks, as they are safe and require no surface space. It is good practice to strain the oil as it passes from tank car to storage and again before it reaches the burner.

Flowing under a pressure of approximately 15 to 25 lb., the oil has sufficient velocity to dislodge or carry small particles of scale or sediment to the fine openings of the burners. In order that the burners may not become clogged, it is well to see that the burners and the piping are perfectly clean each time before attempting to use them. It is a good plan to blow steam through them, before the oil is turned on or the fire lighted. This action also frees the piping of condensate, besides warming both piping and burner, so that oil will flow freely.

A good way to start the fire is to open the damper and then throw some ignited waste into the furnace a few inches in front of the burner tips. Turn on just enough steam to carry the oil out to the burning waste. When good ignition has been secured, open the oil and steam valves to produce the desired fire, remembering that it is best to turn on a little less steam at the beginning, even though smoke is produced, since too much steam is apt to blow out the flame. After the furnace has become thoroughly heated, more steam can be turned on and adjustments made to produce smokeless combustion.

A fire burning in surges indicates an unsteady flow of oil. Should the flame go out and fail to ignite, the oil supply should be cut off and the steam turned on full to clear the combustion chamber and the stack of volatile gas that may explode. The fire then should be restarted with waste, as if lighting a new fire.

To increase a fire, open the oil valve first, then the steam valve. To decrease a fire, close the steam valve first. Too little steam will produce a reddish flame, where too much steam will cause a puffing or surging action similar to that produced by momentary stoppages of fuel. Perfect conditions are indicated by a clear and almost white fire. When shutting down, decrease the fire by almost closing the oil valve; then close this valve entirely and open the steam by-pass valve to free the burner of oil and leave it clean until it is again needed.

Thermal Cutouts for Protecting Alternating-Current Motors

By H. D. BRALEY
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Thermal cutouts for overload protection compared with protective devices that provide short-circuit protection; the characteristics of devices for properly protecting motors against overloads, and types of thermal cutouts

THERMAL cutouts constitute the second class of circuit-interrupting devices and were developed primarily to provide overload protection for small motors. Overload protection is used here in a literal sense, for it does not necessarily include short-circuit protection, although some types of protective devices serve both purposes. For example, a circuit breaker if controlled by both instantaneous overcurrent and inverse time-limit overcurrent attachments provides both short-circuit and overload protection.

The thermal cutout may be defined as an overcurrent protective device containing a heater element which affects a fusible member that opens the circuit. The heater may be a coil, a resistive conductor or any heat device responding to the current flowing in the protected circuit.

The basic principle of any thermal protective device is the reproduction of heat proportional to that generated in the protected equipment. As applied to motor protection this may be better understood by considering the means by which heat is generated and dissipated under operating conditions. Heat transfer takes place between two bodies when their absolute temperatures are maintained at different levels. If no difference in temperatures exists, no heat transfer takes place.

Heat Dissipation From Motors

When a motor is operated under light-load conditions some of the heat generated by the iron is transferred directly to the air and some through the insulation and copper which are imbedded in the iron, and is dissipated from the winding surfaces exposed to the ventilating air. At full load or small overloads the process may be reversed and some of the heat generated in the copper may flow to the iron. In either case the rate of heat transfer through the insulation will be low, because of its poor heat-conducting qualities. The effective thermal capacity of the motor is determined by the entire mass of material used in its construction. A comparatively long time is required to reach a constant temperature, that is, when the rates of heat production and liberation are equal.

Under severe overloading conditions the heat generated in the iron remains practically the same as that under light-load conditions, but heat in the copper is generated faster than it can be dissipated, with the result that a dangerously high temperature is attained.

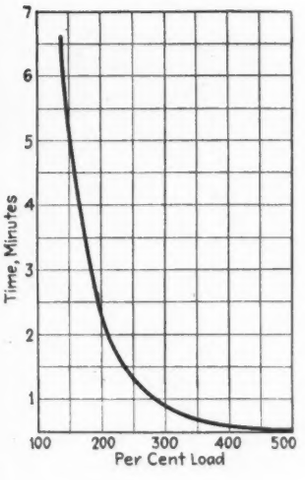


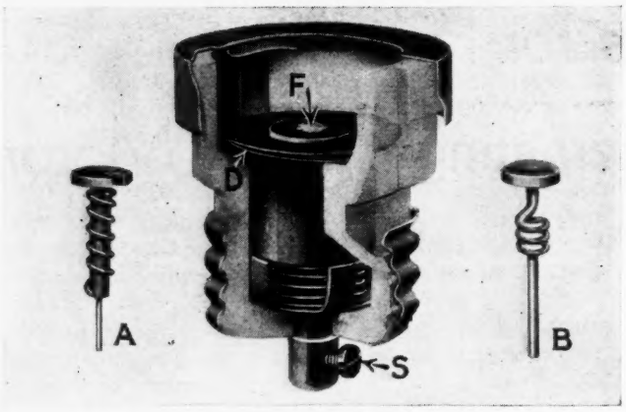
Fig. 1 (Left)—General Electric plug-type thermal cutout

Fig. 2 (Right)—Average operating characteristics of the thermal cutout, Fig. 1

For example, if full voltage is maintained at the terminals of a stalled motor the copper loss may be 30 to 60 times the normal full-load value. The thermal capacity of the motor in this case is that existing in the copper alone.

To protect a motor under all operating conditions the protective device should have operating characteristics which closely follow the heat-time curve of the motor. It should therefore have a long time lag under small overloads and a short time lag under large overloads.

The thermal cutout is essentially a thermally lagged device. The heater element serves this purpose, its heat being transferred at a comparatively slow rate to the fusible element and thus represents the thermal capacity of the motor. Since the locked-rotor current represents the most severe overload to which a motor can be subjected, assuming normal voltage and frequency, the cutout is usually designed to protect for this condition. This may result in tripping the motor somewhat more quickly than necessary to protect it properly under less severe overloads. In other words, the cutout is adjustable for only one point on the motor time-temperature curve, but it nevertheless provides better protection than the ordinary fuse although not so good as that furnished by certain types of temperature relays to be discussed in a future article.



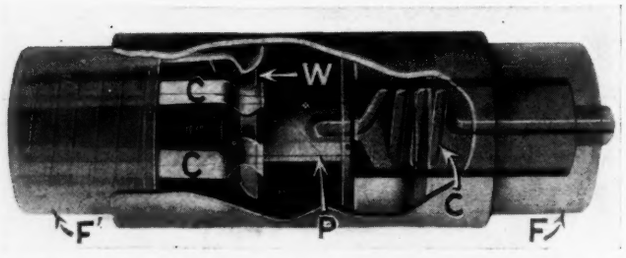


Fig 3 (Above)—Westinghouse plug-type thermal cutout

Fig. 4 (Below) — Westinghouse cartridge-type thermal cutout

To avoid excessive burning of the contacts some means must be provided in all circuit-rupturing devices to operate quickly when the circuit is broken. A spring mechanism is employed for this purpose in the thermal cutout, one terminal of the fusible element usually being connected to the spring under tension and the other terminal connected to a fixed point.

It has been indicated in previous articles, July 28 and Aug. 11 numbers, that a fuse has the combined properties of a circuit interrupter and relay, but that its properties as a circuit interrupter are superior to those as a relay. The reverse is true of the thermal cutout, for it has a limited excess-circuit capacity. But it is superior to the fuse as a relay for overload motor protection. This limitation in rupturing capacity requires the use of suitable back-up short-circuit protection. This may be a fuse or circuit breaker with instantaneous tripping action. However, the cutout does have sufficient capacity to rupture the current drawn by a stalled alternating-current induction motor. This value ordinarily does not exceed six times, and rarely eight times, rated full-load motor current. The lower values are obtained for the usual speed ranges and the higher value for high-speed motors.

Plug-Type Thermal Cutouts

The plug-type thermal cutout is not suitable for the protection of direct-current motors, since the rupturing capacity required for direct-current arc extinction is beyond the range of their rupturing ability. The cartridge-type cutout may be used on direct-current service of 250 volts or less, provided a rheostat is used to start the motor and the current under stalled-motor conditions does not exceed 50 amp. In such applications the motor is protected only when the starting device is in the running position.

These limitations to direct-current use are readily understood from the viewpoint of arc rupture. Alternating current can be more readily interrupted than direct current, other things being equal. The alternating-current wave becomes zero at each half cycle and consequently less energy must be dissipated if the current is broken near this point than when interruption takes place at the maximum value, as in direct-current circuits.

A General Electric plug-type cutout is shown in Fig. 1 and its average operating characteristics are given by the curve Fig. 2. The stationary contact post, Fig. 1, contains a heating coil *A* and a fusible link *B* which binds a spring contact arm *C* to the stationary post. The fusible link is made in two parts held together by a low-fusing alloy. The current circuit is completed through the heating coil, contact post, link and spring contact arm. The heat from the coil is communicated to the contact post, and in case of a sustained overload melts the alloy of the fusible link. This releases the spring contact arm, which snaps to the position shown by the dotted line *D*, thus opening the circuit.

To place the cutout in operation again the spring contact must be returned to its original position and a new link installed. The same fusible link is used for all cutout ratings, as it is not fused directly by its own losses, but by the heater. The watts expended in the heater is the same for all current ratings, so that a different heater is required for each rating. Since the heater is a built in part of the complete device, it is necessary to change the complete cutout if a different rating is required. These ratings vary from 0.59 to 0.70 amp. in the smallest to 14.7 to 17.5 amp. in the largest size.

Cartridge-Type Cutouts

Westinghouse thermal cutouts are made in both the plug type, Fig. 3, for the smaller ratings and in the cartridge type, Fig. 4, for larger ratings. Their performance curves are shown in Fig. 5. The thermal

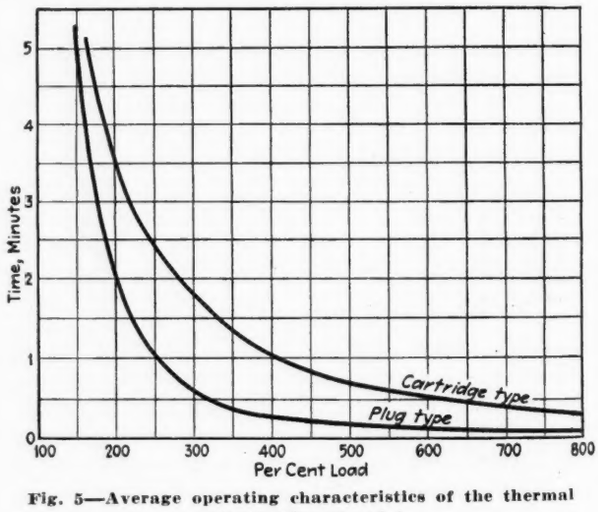
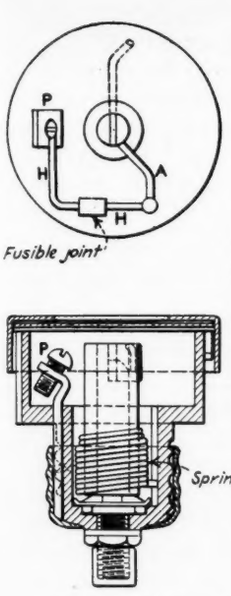


Fig. 5—Average operating characteristics of the thermal cutouts, Figs. 3 and 4

element, Fig. 3, consists of a heater fastened by a fusible alloy to a copper disk, either with a tube as at *A* or directly as at *B*. This heater element, or refill, is held in place against spring pressure by means of the small screws *S* at the bottom of the cutout. The stem of the refill unit is of the resistive-conductor type. The heat generated in it by the motor current is conducted to the fusible joint *F* connecting this member to the copper disk *D*. When an overload of sufficient magnitude occurs to melt the low-fusing alloy the circuit is broken by the spring quickly forcing the copper disk from contact with the heater element. The rating of this cutout



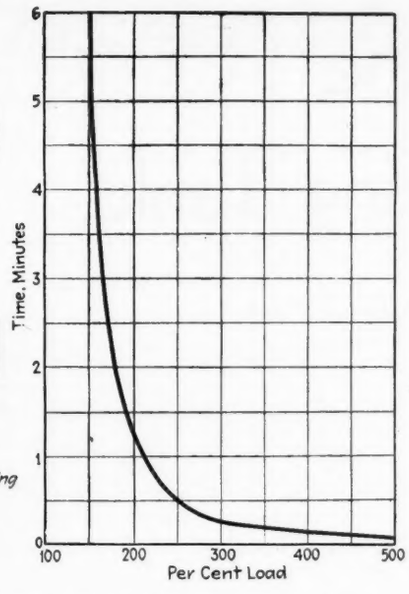


Fig. 6 (Left) — Section through a Condit plug-type thermal cutout

Fig. 7 (Right)—Average operating characteristics of the thermal cutout, Fig. 6

is controlled by the rating of the refill unit, all other parts being the same for all ratings. Standard ratings are obtainable from 0.6 to 5.7 amp. at 600 volts up to 24 amp. at 250 volts.

The cartridge-type cutout, Fig. 4, operates on the same principle, but its design is adaptable for ratings of from 1 to 12 amp. at 600 volts and up to 35 amp. at 250 volts. The circuit is made up from the right-hand ferrule *F*, through the heater coil *C*, heater post *P*, refill washer *W*, finger contacts *C* and left-hand ferrule *F'*. The refill washer consists of two concentric rings or washers sweated together by a fusible alloy. The inner ring of the refill rests on the heater post and is held in this position by the contact fingers acting under spring pressure against the outer ring. Heat is conducted by the brass heater post to the refill washer, and when a sufficient overload occurs, the fusible alloy, holding the two parts of the washer together, melts and the outer ring is forced quickly away by the spring, thus interrupting the circuit. The same size of washer is used on all ratings, but the entire cutout must be changed when different ratings are required, as the heating element is built in as an integral part of the device.

The Condit Electrical Manufacturing Company's plug cutout shown in Fig. 6 employs a still different construction, but here again the principle is the same. The heater element *H* consists of two sections of high-resistance wire joined by a fusible joint. In case of a sustained overload of sufficient magnitude the fusible joint melts and releases the contact arm *A*, which springs to the dotted position and interrupts the circuit. The characteristic operating curve is given in Fig. 7. These cutouts are furnished in capacities from 1 to 18 amp., 600 volts, the current rating being stamped on the fusible joint.

The successful operation of all types of thermal cutouts is dependent on the special alloy used in the fusible joint; no attempt should be made to resolder the links, as this may result in changing the characteristics to such an extent that the motor may burn up on overload before the cutout will operate.

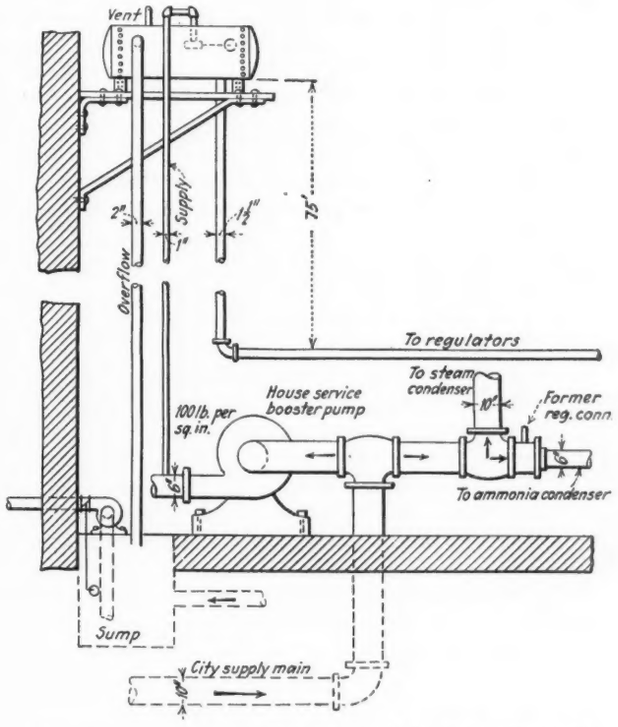
Constant Pressure for Hydraulic Regulators

By H. M. SPRING

A REFRIGERATION unit of the ammonia-compression type was installed recently in an industrial plant. The water supply to the plant was through a 10-in. line from the city main several blocks away. With the usual flow through this line the average discharge pressure at the boiler-room floor level was 50 lb. The water supplied the regular make-up for three boilers, a small steam condenser, house-service system and several hydraulic damper and pressure regulators. The regulator pilot valves were set to operate at from 30 to 5 lb. pressure.

To make a direct run of pipe without cutting through a concrete wall and floor the water line to the ammonia condenser was tied into the house main just before the branch line supplying the regulators. When the water was turned on for the ammonia condenser it was found that the pressure on the regulators dropped to such a low value that they would not operate correctly.

As nearly 100 ft. of headroom was available under the boiler-room roof, a 50-gal. tank was placed at about 75 ft. elevation, to give sufficient head to operate the regulators. The maximum amount of water to open and close the regulating valves was determined, and a ½-in. line was run from the house-service booster pump to the tank to supply this service. A float valve in the tank controlled the water level. A vent and overflow were connected as shown.



Arrangement of connections to and from gravity tank

After this was connected up the regulators had 32 lb. pressure on them regardless of the pressure drop in the house main, which was never enough to bring the booster pump discharge below 75 pounds.

Brine Agitation in the Ice Freezing Tank

By LEON BUEHLER Jr.
The Frick Company

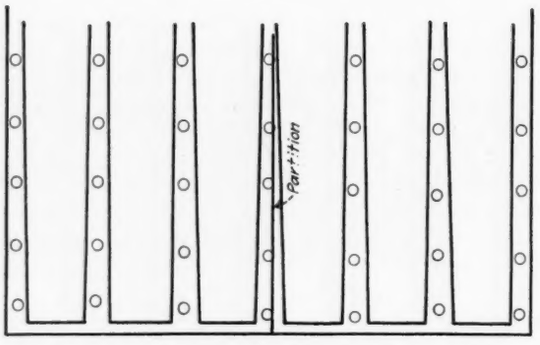


Fig. 1—Tank with coils between the ice cans

THERE is probably no other item of ice plant operation that receives less attention than the proper circulation of brine in the ice freezing tank. There is, also, no other point at which the efficiency of most of the older existing plants can be improved at such low cost. It is only in the past few years that engineers have fully appreciated the possibilities of faster brine circulation and devised the means for the accomplishment with very low power consumption. Rates of heat transfer have been greatly increased in modern refrigeration condensers and evaporators but the older designs worked just as effectively if enough surface was installed originally. Improved agitation will raise the efficiency of both the cooling surface and the can surface in the freezing tank.

Brine is circulated to permit the freezing of the maximum quantity of ice in a given number of cans at the highest possible brine temperature and the highest possible ammonia temperature with the evaporating surface furnished, and to freeze the ice at a uniform rate over the entire tank. In short the purpose is to make ice economically in the least space and with a minimum of equipment.

The freezing time of ice is computed by the following formula:

$$H = \frac{A\,t^2}{32\text{-}T} \text{ where}$$

H = the freezing time in hours.
t = the width of ice at the top (narrow way).
A = a constant.
T = the brine temperature.

The constant A depends upon brine velocity past the cans, can submergence, the kind and density of brine, the temperature of water to the cans, the character of the water, the size of the core pulled, the temperature of core refill water, whether air agitation is supplied to the can water and perhaps several other factors.

For the quickest freezing at a given brine temperature A must be a minimum, which occurs when the brine velocity past the cans is high, the brine is not too strong, the finished block of ice submerged an inch or two below the brine level, soft water at a low temperature is provided, a small core is pulled, and the can water is agitated by air. With all other factors reasonably favorable A will range from 5.75 to 6.5 at brine velocities of from 40 to 25 ft. per minute. With 10 to 15 ft. per minute brine velocity, A is about 7 and with poorer agitation and other factors unfavorable the value of A mounts rapidly. A great many freezing tanks are in operation with brine velocities of less than 10 ft. per minute, so that with improved agitation 10 to 15 per cent more ice could be harvested at the same brine temperature, (providing sufficient compressor capacity is available), or the same amount of ice could be harvested at from 1.5 to 2.5 deg. higher brine temperature.

In addition, if the velocity over the cooling surface is correspondingly increased the heat transfer may be raised as much as 60 to 70 per cent, which may result in an increase of as much as 5 pounds per square inch in the ammonia suction pressure. But such great improvement is not to be expected in all cases. It is not intended to treat the subject of heat transfers with respect to brine velocities in sufficient detail in this article to give a basis for estimating economies to be expected. A competent engineer, however, can estimate closely the operating conditions.

A cross section of a typical ice freezing tank with coils between the cans appears in Fig. 1. If no agitation is provided for a tank of this character there will be some movement of the brine by convection, the colder brine dropping to the bottom and the warmer brine

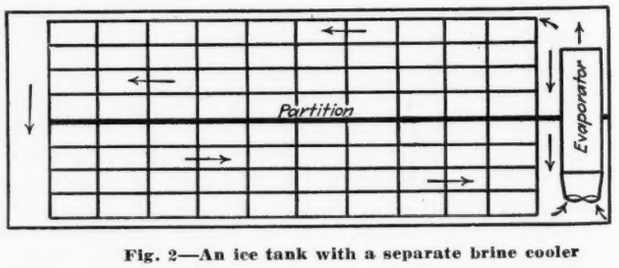


Fig. 2—An ice tank with a separate brine cooler

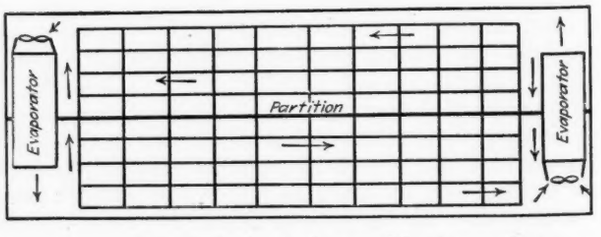


Fig. 3—An ice tank served by two coolers

rising. As a result the bottom of the tank will be considerably colder than the top. The ice can is largest at the top and therefore freezes shut at the top last in any event but the warmer brine at the top greatly magnifies this effect, so that the ice block takes unduly long to completely freeze. This condition is entirely aside from the otherwise slow freezing due to stagnant brine. It is quite evident that some agitation is required to

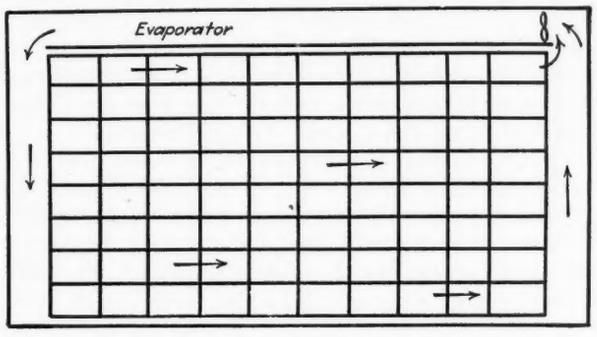


Fig. 4—Design in which the evaporator coils are at one side of the tank

equalize the brine temperatures between the top and bottom of the tank.

An ice tank with a separate evaporator is shown in Fig. 2. Brine must be circulated through the evaporator for cooling, then flow past the cans to return to the evaporator for recooling. For each ton of ice produced in 24 hours about 1.6 × 200 or 320 B.t.u. are absorbed by the brine per minute. A cubic foot of brine will absorb about 60 B.t.u. for a rise of 1 deg. in temperature, depending upon the density of the brine. Therefore if the brine entering the evaporator after it has absorbed heat from the cans, is to be 1 deg. warmer than the brine leaving the evaporator and before it has absorbed heat from the cans, it is necessary to circulate 320/60 or 5.33 cu. ft. of brine per minute per ton of ice produced per 24 hours. Referring again to the equation $H = \frac{A\,t^2}{32\text{-}T}$ and assuming brine entering the cooler at 15 deg. F. and leaving at 14 deg., the cans in contact with the 15-deg. brine will require about 6 per cent longer to freeze than those in contact with the 14-deg. brine. As in practice the ice is harvested in a definite rotation the effect is that the capacity of the tank is reduced to the 15-deg. condition. Hence it is necessary to limit the rise in brine temperature throughout the tank by circulating sufficient brine. Good practice dictates not much over ½ deg. rise requiring from 8 to 12 cu. ft. of brine circulation per minute per ton of ice produced per 24 hours.

Freezing-Tank Designs

A number of typical freezing tanks are illustrated in Figs. 2 to 7 with brine flow indicated by arrows. Tanks with evaporators separate from the can space are covered by Figs. 2 to 4, while Figs. 5 to 7 indicate tanks with coils between the cans. Many modifications of these layouts may be made. Changes of direction in the brine flow are to be avoided as far as possible. Wherever the flow makes a turn it is well to provide liberal unrestricted passage. The least desirable arrangement is that of Fig. 7, as the brine from the agitator impinges directly against the cans, causing them to tilt or brine to splash into them. It is better to build up a head of brine in a space in front of the cans as in Fig. 5. Partitions and bulkheads should be carefully installed so as to be reasonably tight. While the pressure difference on opposite sides of partitions is slight, the seams are so long that poor fitting will result in serious leakage.

From a viewpoint of rapid freezing and high rates of heat transfer high brine velocities are desirable but practical considerations limit the velocities that can be used. As the freezing tank is open at the top the brine level corresponds with the hydraulic gradient, that is, the agitator builds up a brine level several inches higher at its discharge than at its suction and the brine flows by gravity from the high point to the low point. The higher the brine velocity the greater must be this level difference. As it is necessary to keep all cans well submerged this level difference must be kept within about 3 in. Tanks designed along the lines of Fig. 4 are frequently pitched to correspond with the expected brine level difference to assure equal submergence of all cans. Even in that case there is a limit to the permissible brine level difference, for when the agitator stops the brine must not overflow in to any of the cans.

It is not practical to rigidly fix the cans in the tank so that they will not tilt objectionably when the brine velocities get too high. This applies most particularly to tanks with loose cans rather than to groups of cans held in baskets or grids.

Power for Agitation

The power required for agitation is a further limiting factor. Quite naturally, since the higher brine velocities impose additional head on the agitator, the power to circulate a given quantity of brine increases. To limit the quantity of brine that must be circulated, the cans may be spaced very closely so as to reduce the area of the brine pass. If the cans are spaced so that

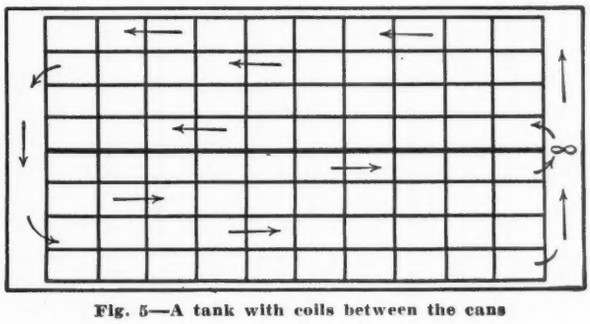


Fig. 5—A tank with coils between the cans

the bands touch it is impossible to further reduce the area so that still higher velocities would then require excess brine quantity further increasing power requirements. All of these considerations fix the practical brine velocities at from 25 to 40 ft. per minute.

Where a shell and tube brine cooler or a set of nested coils is used it is possible to circulate the brine at higher velocities over the evaporating surface than the brine had when passing the cans. Here again it is desirable to use the highest practical velocity so as to operate at the highest heat transfer and save in space and first cost of cooling surface. Power requirements and the limited head against which propellers will operate are the limiting factor. Present-day practice ranges between 100 and 200 ft. per minute.

In deciding upon a tank layout there are three requirements namely 25 to 40 ft. per minute velocity past the cans, 100 to 200 ft. per minute velocity over the evaporating surface and 8 to 12 cu.ft. per minute per ton ice per 24 hours. The brine passages must then be

proportioned to meet these conditions. Applying these requirements to a tank space of fixed length and width will largely determine the layout adopted.

About every type of pump has been used to circulate the brine. A propeller similar to a boat propeller is now almost universally used and has proven most satisfactory considering first cost, power consumption, and space requirements. Better efficiency results from the use of large-diameter propellers at low rotative speeds than with small propellers at high speeds. For large capacities speeds run as low as 100 r.p.m., while for comparatively low capacities they are as high as 900 to 1,200 r.p.m.

A well proportioned tank of 50 tons or greater ice capacity will require as little as 1 hp. for every 30 tons of capacity although generally it will run closer to 1 hp.

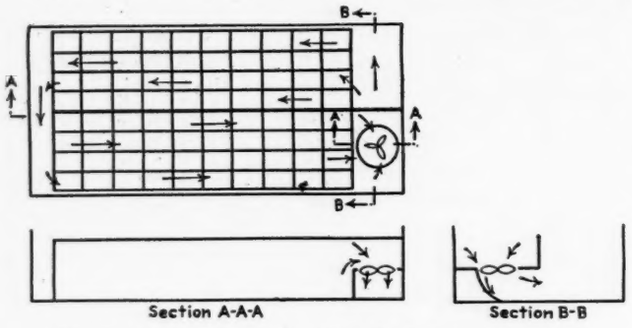


Fig. 6—A modern design with coils between the cans

for every 20 tons. Small tanks of 10 to 15 tons capacity require about 1.5 hp. for agitation. These figures are lower than for many old tanks with their inefficient agitation. In fact often the saving in agitator horsepower alone will warrant replacement of obsolete equipment without considering the even greater saving due to improvement operation of the entire plant.

In considering plant improvements or new installations the agitation horsepower should be carefully analyzed. A difference of 1 hp. is equivalent to about 1 kw. considering motor efficiency. Since the agitator runs whenever the tank is in operation, whether at full or reduced capacity, on an average this means perhaps 300 full operating days per year. Based on current at 1.25 cents per kw.-hr., 1 hp. costs 30 cents per day or

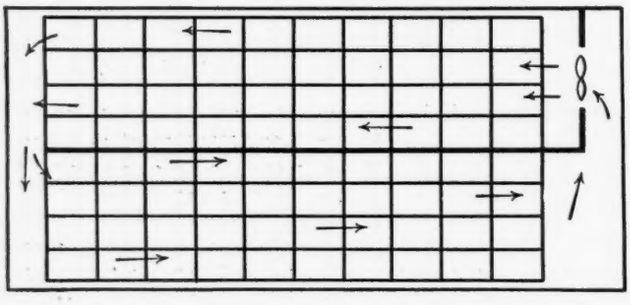


Fig. 7—Another arrangement of tank with coils placed between the cans

$90 per year and capitalized at 16⅔ per cent a saving of 1 hp. will carry an investment of $540. It is well to be wary of claims of high heat transfer in evaporators at the expense of high agitation power unless the investment is reduced sufficiently to pay the extra power bill. Heat transfers as high as 300 to 400 B.t.u. per square foot per hour per degree temperature difference are possible in ammonia evaporators. Brine circulation costs to achieve these results in an ice tank would wipe out all savings in first cost in a few months time.

Diesel Stand-By Power In a Hydro-Electric Plant

By EDWARD SWAN

FREQUENTLY hydro-electric plants are unable to give continuous service by reason of variation in water flow, which compels the installation of some kind of stand-by power; often this service insurance takes the form of diesel engines, as is the case with the Kearney (Neb.) plant of the Central Power Company.

The Central Power Company has a transmission line serving the Platte River Valley in central Nebraska, with the main plant at Grand Island and a hydro plant at Kearney. The stream flow in the Platte River, with its wide sand bottom bed, is extremely erratic. Irrigation of thousands of acres of land often takes all the flow in the summer months, when the river is at low levels at best. In winter slush or cake ice may form ice dams, quickly shutting out the flow to the hydro plant, sometimes without warning. Even in the spring and fall interruptions may occur due to floods bringing down immense quantities of trash, which, of course, jams the intake screens and prevents water reaching the turbines. High winds blow such large masses of weeds and corn shucks into the 17-mile canal that service from the hydro plant may be interrupted almost without warning.

Breakdown Power Necessary

Such conditions call for some form of stand-by units to insure continuity of service in the local district. Until recently breakdown power was obtained from a steam engine plant, but this became too small to carry the load, and high fuel costs and other undesirable features prompted the installation of another power unit.

A summary of the qualities which a stand-by unit should possess included quick starting, no stand-by fuel expense, small amount of water and low fuel cost. Fuel transportation by pipe line was desirable, since the plant was some distance from the railroad. Space was limited unless the existing steam equipment was removed, which the management wished to hold in reserve.

The diesel engine apparently offered the greatest advantages, consequently two 980-hp. engine-generator sets were installed. Since the plant has gone into service the diesel sets have been found to give better local voltage regulation, and have improved the power factor of the main steam plant as well as flattened out the peak load on the main plant. The latter two features improve the efficiency of the main plant, especially since it is possible at times to operate a small steam turbine fully loaded, with the diesels carrying the excess, in place of operating a large turbine lightly loaded.

The installed equipment consists of two 980-hp. seven-cylinder, 257-r.p.m. diesel engines provided with scavenging pumps at the end of the crankshaft. As they are set side by side, they are arranged with starting and governing controls facing each other.

Each of the direct connected generators is rated at 845 kva., 2,400 volts, 3 phases, 60 cycles. The exciters are 15-kw., compound-wound, silent chain-driven at 1,400 r.p.m., as shown in the illustration.

The switchboard is a four-panel unit, manually operated, with two panels for the main generators, one for the exciters and field switches and rheostats and an-

other with a Tirrill voltage regulator and a frequency meter which records on smoked charts.

Starting air for the engines is confined in four (A.S.M.E. Standard) 250-lb., 30-in. x 96-in. tanks, each having a $\frac{1}{2}$-in. safety valve. The air is compressed by a 5 x 4 x $4\frac{3}{8}$ x 5-in. compressor close-belted to a 10-hp., 1,800 r.p.m. motor and a small compressor close-belted to a 30-hp., 1,800-r.p.m. motor.

Lubricating oil for the main bearings and wristpins is pumped into a header along the crankcase of the engine at a pressure of 16 to 18 lb. Connections are made to the main bearings, and from each bearing the oil flows through a hole in the crankshaft and up through a drilled passage in the connecting rod to lubricate the piston pin and cool the piston crown. It returns to telescopic collecting pockets and drops to the bottom of the crankcase, where it is picked up by an oil pump direct connected to the engine and forced through strainers and oil coolers back into the header.

An auxiliary pump forces oil into the header before starting and continues the circulation after the engine is shut down until the oil and engine parts cool down. By the use of two quick-opening valves and a three-way cock the pump can be used on either engine.

Lubrication of the cylinder walls and pistons is by force-feed lubricators, there being three connections to each cylinder. After the oil has functioned as a lubricant it is scraped off of the piston and returned to scraper-ring oil tanks in a pit below the floor level. When the oil has reached a predetermined level it is passed by a $\frac{3}{4}$-in. pump driven by a $\frac{1}{3}$-hp. motor through a 6-kw. electric heater where it is heated to a temperature of 145 deg. and then run through an oil centrifuge.

Cooling water for the engines is taken from the lake above the level of the engine room. The inlet water is strained through a twin strainer and is forced through the lubricating oil cooler into the manifold that connects with all cylinders. After passing through the cylinder jackets it flows into the water-cooled exhaust manifold and to discharge. Arrangement is made to bypass some of this warm water back into the system so that the temperature of the inlet water can be raised in the winter to a safe operating temperature.

The auxiliary oil pump and the cooling-water pumps are controlled by magnetic switches from the floor level.

EQUIPMENT IN CENTRAL POWER COMPANY'S DIESEL PLANT

Engines	Two 980-hp., 7-cylinder, 257-r.p.m., two-stroke-cycle diesels	Fairbanks Morse & Co.
Alternators	Two 845-kva., 2,400-volt, 3-phase, 60-cycle, with 15-kw. chain-driven exciters	Fairbanks Morse & Co.
Switchboard		General Electric Co.
Starting equipment		
Air tanks	Two 30x96-in., 250-lb. tanks	Morrison Bros.
Compressors	One 5x4$\frac{3}{8}$x5 belted to 10-hp., 1,800-r.p.m. motor	Worthington Pump & Machinery Corp.
	One 3-hp. auxiliary compressor	Fairbanks Morse & Co.
Lubricating oil equipment	One 180-g.p.m. Trahern rotary pump direct connected to 10-hp., 1,800-r.p.m. motor	G. D. Roper Corp.
	Two coolers	Schutte & Koerting Co.
	Two 4-in. duplex strainers	Schutte & Koerting Co
	Two force-feed lubricators	Madison Kipp Corp.
	One 45-gal. per hour centrifuge direct connected to 1-hp. Emerson motor	DeLaval Separator Co.
	One 6-kw. electric heater	Westinghouse Elec. & Mfg. Co.
	One $\frac{1}{2}$-in. transfer pump	Geo. D. Roper Corp.
Cooling-water equipment	Two 4-in., 500-f.p.m., 45-ft.-head centrifugal pumps direct connected to 10-hp., 1,800-r.p.m. motors	Fairbanks Morse & Co.
	Pump controls, magnetic type	General Electric Co.
	Control board	Marshalltown Mfg. Co.
Fuel equipment	One 50-g.p.m., pump direct connected to 7$\frac{1}{2}$-hp. G.E. motor	Viking Pump Co.
	Two 10x21-ft., 12,500-gal. steel tanks	Columbia Steel Tank Works
	One 1-in. meter	Mueller Co.
Pyrometers	Two with seven points each	Brown Instrument Co.
Valves and piping		Crane Co.
Heaters	Three No. 5 heaters	Hoffman Specialty Co.
Flooring		Irving Iron Works.

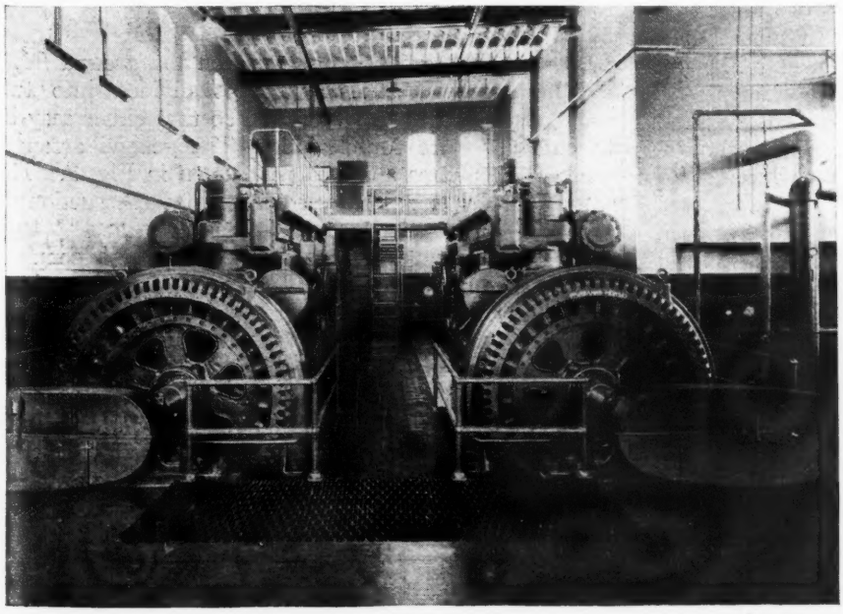
The pumps and oil coolers are in a pit at the end of the engines.

One control board for each engine has mounted on it gages to indicate starting air, scavenging air, water and oil pressures. A 6-volt horn blows if the oil or water pressure falls below a safe limit. A pyrometer for indicating exhaust temperatures is mounted in the center of the board.

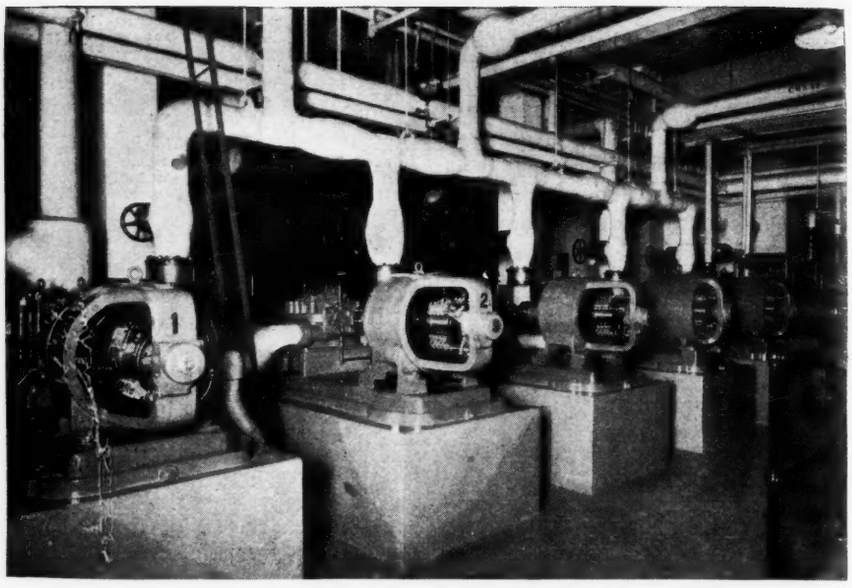
The fuel is pumped from the railroad siding into the two 12,500-gal. tanks and flows to regulators below and between the engines; it is picked up from here by pumps driven directly by the engines and flows into the reservoirs on the engines, from which point it is picked up by the injection pumps and forced into the combustion chambers at the proper time.

Before going into the reservoir on the engine the fuel is drawn through twin strainers of the disk type, where all grit and lint that would cause trouble is removed. Gas oil is the fuel used, and notwithstanding the fact that there is a very poor load factor the fuel consumption over a year's period was 0.615 lb. per kilowatt-hour.

The building being located on the side of a hill it was found necessary to reinforce the wall on the up-hill side; this was done by large counterforts of reinforced concrete, the air intake and the exhaust pits being incorporated in the design. The walls adjacent to the pits were underpinned at the time the counterforts were built.



The two 960-hp. diesel generating units are placed side by side, one engine running over and the other under. The exciters are chain-driven, with the chains inclosed in a metal guard



Five house-service pumps supply water to tanks located on three levels in the building

Flexibility Features Pump Equipment in the Lincoln Building

By B. C. CORBALIS and W. DEVAUGHN
Chief Engineer *Chief Electrician*

House-service and fire pumps are so arranged that water can be supplied to the fire system in at least four ways and to the house-service tanks in not less than two ways. The house-pump motor controls are unusually flexible and permit of several combinations of automatic or manual starting of the pump motors

A WATER SUPPLY to a modern office building must be practically 100 per cent reliable. First on account of fire-law requirements and second because of the thousands of tenants whose comfort and health depend upon an unfailing water supply. Because of the height of these buildings, the water must be pumped from the street mains to tanks at different levels in the building. Various combinations of tanks and pumps are employed for this service. In most buildings all the house pumps are in the basement. The fire laws of New York City require that in buildings over 400 ft. high fire pumps be placed at specified levels up through the building. In some buildings the house-service pumps are also placed on the same levels with the fire pumps.

A number of combinations of house pumps have been worked out to provide duplicate service. In the Lincoln Building, New York City, which is 53 stories high, five pumps supply water to three levels. The five pumps are arranged to give at least duplicate service to each tank. To meet the city fire laws the fire pumps are installed on three levels, the basement, 16th and 33d floors.

Water is brought into the building from a main in 41st St. and from another in Madison Ave. These lines are 6 in. in diameter. On entering the building each includes a gate valve, a fish trap, a meter, a 2-in. test tee, a 6-in. check valve and another gate valve. The two lines tie together and connect to a 10,000-gal. suction tank in the basement for the house pumps and to a 10,000-gal. fire-pump suction tank on the ground floor. The house-service suction tank is divided into two 5,000-gal. compartments arranged so that either may be cut out of service for cleaning. The general arrangement of the pumps and tanks is shown in Fig. 2. The bottom of each compartment connects to the suction of the house-service pumps by a 6-in. line.

All five of the house pumps connect to a common header on both the suction and discharge through valves, so that any pump may be taken out of service for inspection and repair. No. 1, the low-rise pump, has two stages and a rating of 250 g.p.m. against a 290-ft. head. Pumps 2 and 3 have four stages, are for intermediate service, and deliver 250 g.p.m. against a head of 500 ft. Pump No. 2 is used as a spare for either the low-level or the intermediate-level service. A suitable valve arrangement has been provided so that it may readily be cut in or out of either service. No. 5 is the normal high-level pump. It has four stages and will deliver 125 g.p.m. against a 760-ft. head. No. 4 pump is a duplicate of

No. 5 and is normally the high-level spare. It may, however, be used as the intermediate- or the low-level spare if necessary.

On the different levels the water-storage tanks are arranged to suit the space available. The low-level tank is for a combination of fire and house service and has 5,000 gal. capacity for fire and 20,000 gal. for house service. This tank is divided into two compartments. Both compartments are normally in service, but either may be cut out for cleaning and inspection. The discharge from the low-level pump comes into each compartment through a float valve, the water level in the two compartments being maintained through the fire- and house-service connections. A 6-in. cold-water supply comes from this tank and goes to the horizontal mains on the 15th floor to supply that floor and all floors below. A 5-in. line runs to the hot-water heaters in the basement, which supply hot water up to and including the 15th floor.

For the intermediate-level service the house- and fire-service water is supplied from separate tanks, the house-service water tank being on the 30th floor and the fire tank on the 34th floor. The former has 15,000 gal. capacity and is divided into two parts by a vertical partition. A 4-in. line connects the intermediate-level house pump

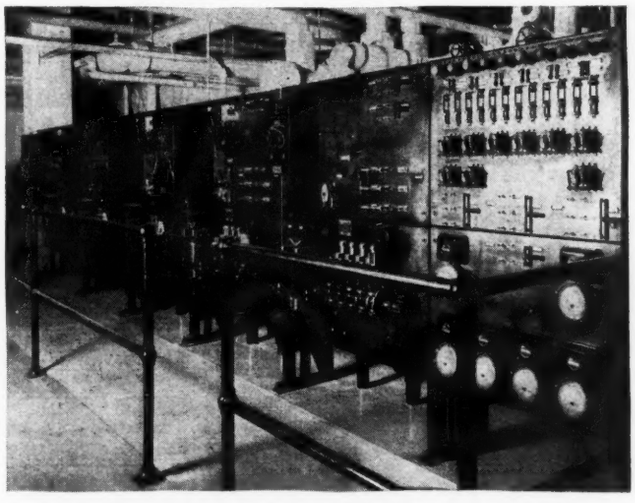


Fig. 1—Control and low- and high-water alarm panels for the house-service pumps

with this tank, from which a 6-in. line goes to the cold-water horizontal mains on the 28th floor to serve that and all floors down to the 16th. Another 4-in. line goes to the intermediate-level hot-water heaters on the 16th floor, which serve all floors from the 16th to the 28th inclusive.

A 10,000-gal. house tank on the 53d (mezzanine) floor supplies all floors above the 28th with cold water. This tank is connected to the high-level pumps in the basement by a 4-in. line. As are the other tanks for house service, it is divided so that either compartment may be taken out of service for inspection and cleaning. A 6-in. line connects the tank with the cold-water horizontal mains on the 52d floor and a 4-in. line runs to the high-level hot-water heaters on the 29th floor.

As previously mentioned, the fire pumps are on three levels, the basement, the 16th and the 33d floors. Water for the basement fire pump comes from the street mains into a 10,000-gal. suction tank on the 42d St. floor level. A float valve maintains this tank full at all times. It connects to the suction of a 750-g.p.m. fire pump by an 8-in. line. As the tank is above the fire pump, the latter's suction is always under pressure. A bypass around the fire tank connects the pump's suction to the incoming lines from the street, so that in an emergency the pump can take water directly from the street mains. For test purposes this pump is bypassed back into the fire suction tank, and in case of excessive pressures a relief valve opens the pump's discharge to this tank also.

In operation this fire pump discharges to the entire standpipe system. The fire lines up to the 14th floor

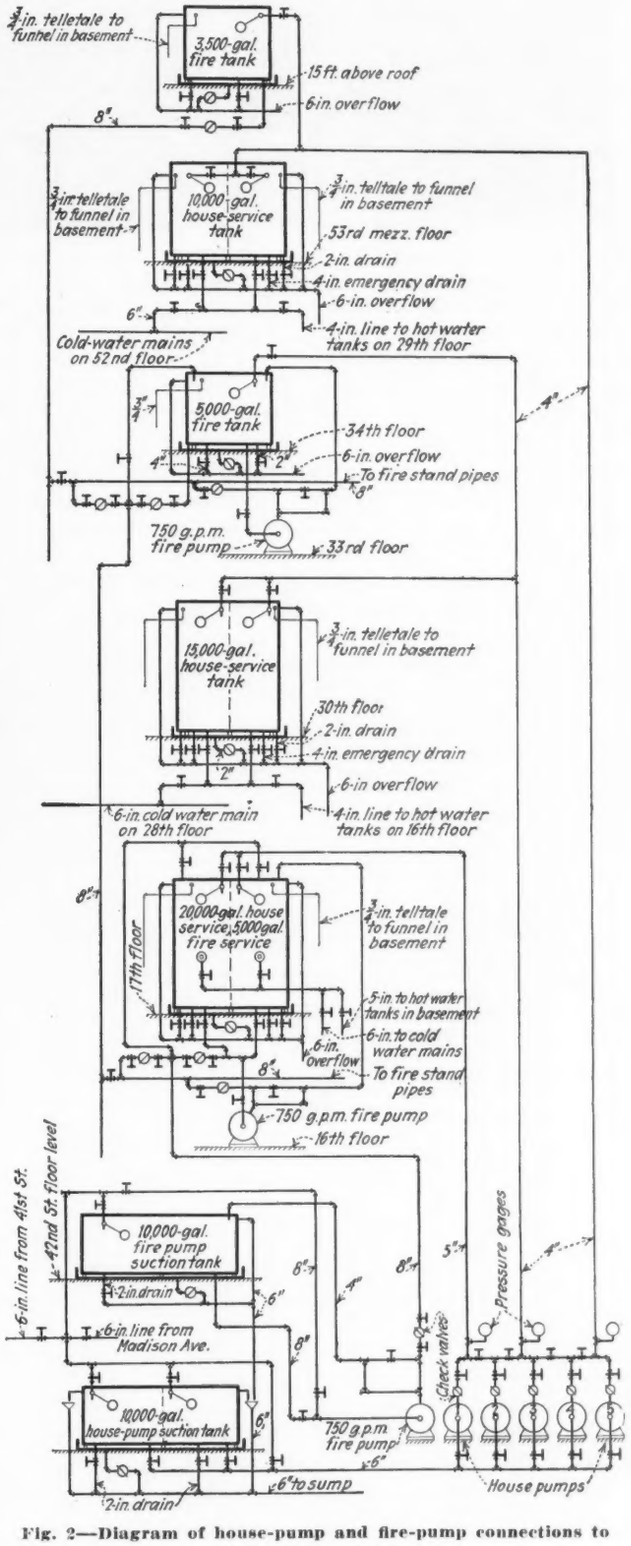


Fig. 2—Diagram of house-pump and fire-pump connections to their storage tanks

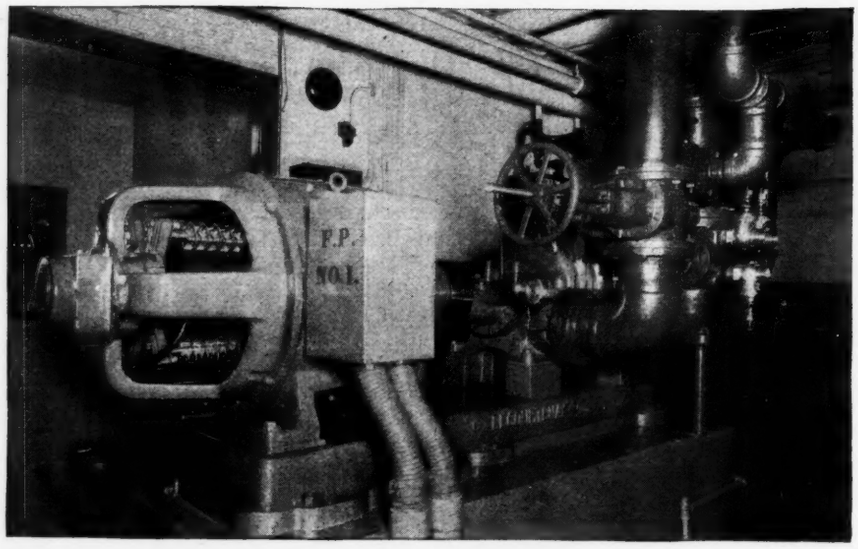


Fig. 3—Fire pump in the basement. This pump is driven by a 200-hp., 1,150- to 1,750-r.p.m. motor and the control is arranged for ten points of speed regulation by field adjustment

are continually under pressure from the combination fire and house tank on the 17th floor. The basement fire pump develops sufficient pressure to discharge into the fire tank on the 34th floor. The combination house and fire tank on the 17th floor is kept filled by either No. 1 or 2 house pumps, or in an emergency any of the house pumps can be used. In case these sources fail the fire pump can be used. In other words, there are six ways of supplying water to the combination fire and house tank.

A 5,000-gal. storage tank on the 34th floor maintains pressure on the fire lines for the intermediate floors. The fire pump for these floors is on the 16th floor and has its suction connected to the bottom of the combination fire and house tank on the 17th floor. It has a normal capacity of 750 g.p.m. against 650-ft. head and when running maintains pressure on the fire lines up to the roof. Normally the fire tank is maintained full by the two intermediate-level pumps, but in an emergency it can be filled by the basement or the 16th floor fire pumps or either of the two high-level pumps in the basement. Consequently there are six ways of supplying water to this tank.

The fire tank for the high-level floors is about 15 ft. above the roof and has 3,500 gal. capacity. This tank maintains pressure on the fire lines down to and including the 32d floor and is normally filled by either of the two high-level pumps. A 750-g.p.m. fire pump on the 33d floor discharges into the fire line supplied from the high-level fire tank, the suction of this pump being connected to the 34th floor fire tank. The fire pump on the 16th floor can develop sufficient pressure to supply the fire line connected to the high-level fire tank. From the

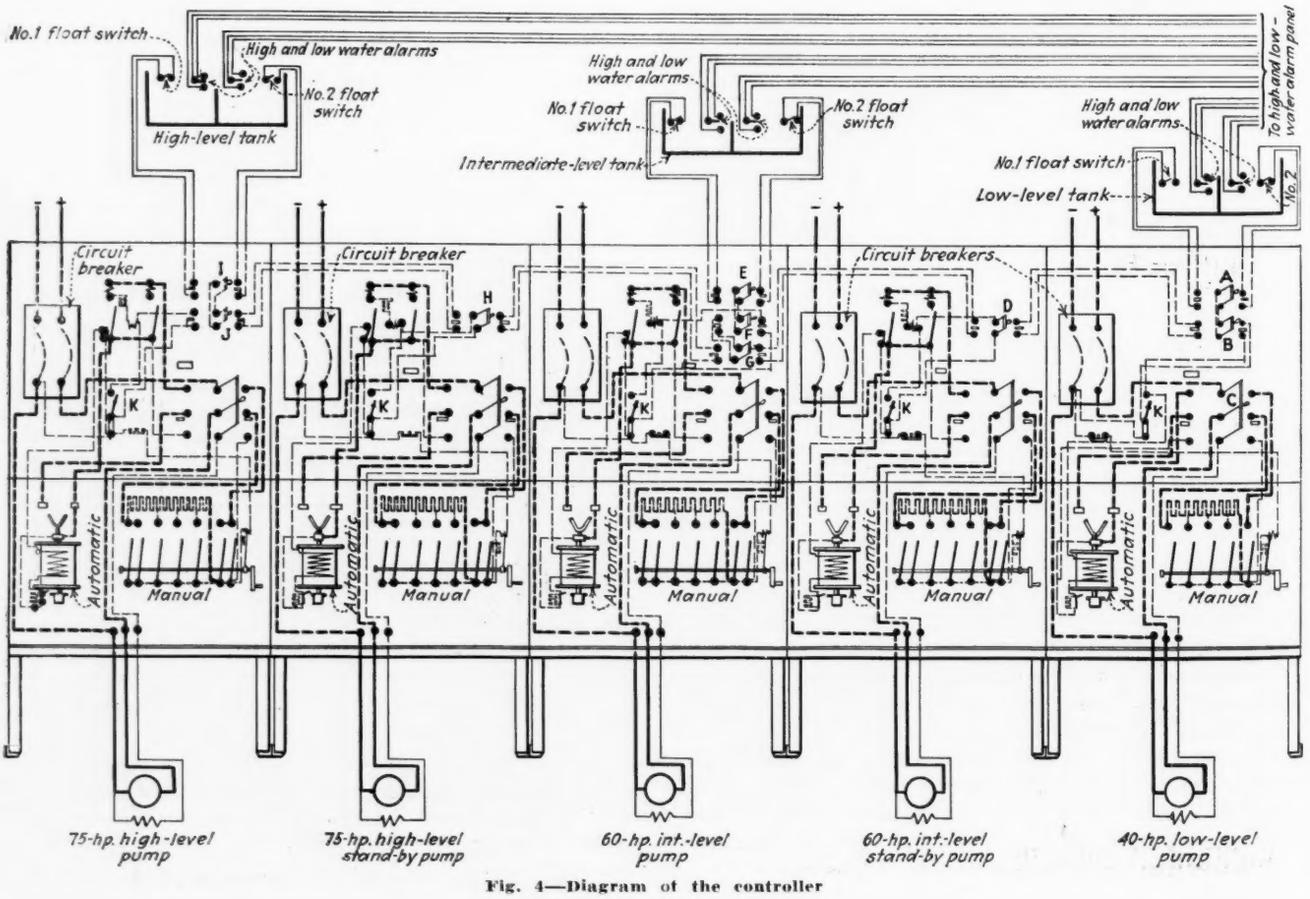


Fig. 4—Diagram of the controller connections for the house pumps

foregoing it may be seen that the pumps are so arranged as to provide at least a duplicate house service and a quadruple fire service.

The discharge into all tanks is controlled by float valves. The tanks are also provided with high- and low-water alarms, and a ¾-in. high-water telltale pipe, from each tank compartment, is run to a funnel in the basement. In case of high water in a tank the telltale overflow will show in the basement if the alarm fails to function. A 6-in. overflow is provided from all tank compartments, and from the bottom of the tanks are a 2-in. drain and a 4-in. emergency drain. The overflows and drains are grouped from each tank and led to the nearest set-back roof of the building.

All pump motors are protected with automatic circuit breakers mounted on the control panels. The panels for the house-pump motors provide for either automatic or manual starting. The diagram for the electrical connections is shown in Fig. 4. Each compartment of the house tanks has a float switch and a high and a low-water alarm switch. The float switches on the low-level tank on the right connect to two double-throw two-pole switches *A* and *B* on the control panel for the low-level pump. When these switches are closed to the right the low-level pump is on automatic control from No. 2 float switch. With switch *A* to the left and *B* to the right the low-level pump is on automatic control from No. 1 float switch. Closing switch *C* to the right puts the low-level pump motor on manual control.

On the panel for the intermediate-level stand-by pump there is a double-throw two-pole switch *D* in the float-switch circuit. When this switch is closed to the right, and switches *A* and *B* are closed to the left, the intermediate stand-by pump motor is under the control of No. 1 float switch in the low-level tank. By throwing switch *A* to the right the motor can be controlled from low-level float switch No. 2. Either one of these arrangements may be used when the intermediate stand-by pump is on low-level service.

On the intermediate-level pump-motor panel there are three two-pole, double-throw switches in the float-switch circuit. When *E* and *F* switches are closed to the right the intermediate-level pump motor is controlled by No. 2 float switch. Closing switch *E* to the left and leaving *F* to the right puts the motor under control of float switch No. 1. If switches *E* and *G* are closed to the right and *D* and *F* to the left the intermediate-level stand-by pump motor is put under control of float switch No. 2 in the intermediate-level tank. Throwing switch *E* to the left and leaving the other switches as before, the stand-by pump motor will be started and stopped from float switch No. 1.

Double-throw switch *H* on the high-level stand-by pump motor panel allows connecting this motor for operation on the float switches in the high-level or the intermediate-level tanks. With switch *H* closed to the right, switch *E*, *F* and *G* may be closed to put the high-level stand-by pump motor under the control of either No. 1 or No. 2 float switches in the intermediate-level tank. From this it is seen that the two stand-by pumps and the intermediate-level pump can be automatically controlled from the float switches in the intermediate-level tank.

The control of the high-level pump motor from the float switches in the high-level tank is through double-throw switches *I* and *J*. By closing switch *H* to the left on the high-level stand-by pump panel, this pump can be put under the control of either of the float switches in the high-level tank, depending upon how switches *I* and *J* are closed.

On each of the control panels there is a single-pole knife switch *K* that when closed short circuits the float switch. This switch allows starting the motor on automatic control when the float switch is open. If the float switch circuit fails to function and low water is indicated by the low-water alarm, the control can be tested by closing switch *K*. If the cause of the motor's failure to start was in the control it would be indicated by the control's failing to function when switch *K* was closed. Under these conditions the three-pole power switch could be thrown to the right and manual control used to start the pump.

All the fire pump motors have manual control. The pump in the basement and on the 16th floor have 200-hp., 1,150- to 1,750-r.p.m. motors, and the control is arranged for ten points of speed regulation by field adjustment. On the 33d floor the fire pump is driven by a 150-hp., 1,150- to 1,750-r.p.m. motor with five points of speed control. In case of fire the pumps are started and their speed regulated by attendants stationed at them, according to telephone instructions given by the chief engineer who has charge of extinguishing the fire.

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Elevators Run on Curved Guide Rails

WHEN the great airship Akron soared on its maiden journey it left from the biggest room in the world. Ten football games could be played at once in this single room in which the navy's new record-sized airship has been constructed in the Ohio city which gives it its name. This huge rounded structure is really all ceiling, as it has no side walls—just one great curved roof that sweeps over the whole giant space. This is what made the unique elevators that run around curves necessary. In building an airship a large crew of men has to work high up on the inner side of the hangar. When it is

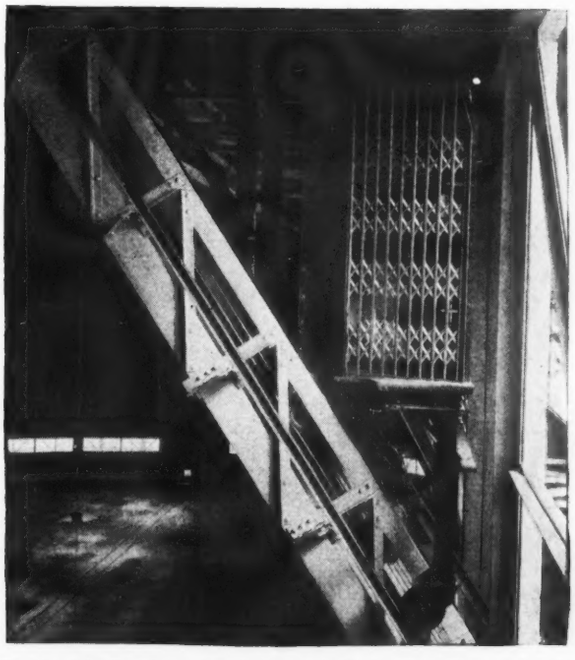
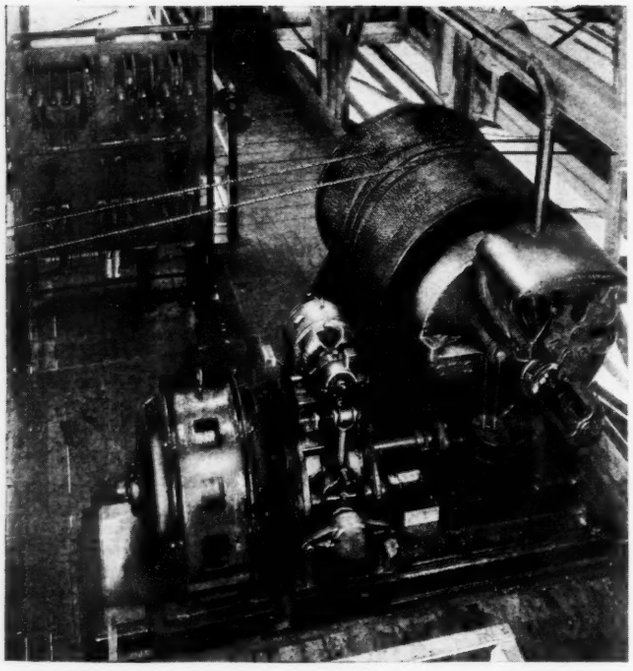


Fig. 1—The hostway is curved but the car remains vertical



One of the elevator machines

finished and in use there must be provision for easy inspection of all parts and it must be convenient to do repair work. Quick and comfortable transportation to the heights of the ceiling is necessary.

The elevators are at the center of the building, one on each side. Instead of having a straight hoistway, they follow the curve of the hangar roof, so they have been provided with a curved track. The Otis Elevator Company, which designed them, provided the elevators with an ingenious system of guides and rollers which keep the car upright at all times in spite of the curving path, as in Fig. 1. The cars can be operated from a station in the ceiling of the hangar or each car may be handled independently by a passenger operator.

At the top of the hangar a platform running the full length of the building furnishes footing for the workmen. Woven through the steel supporting structure on various levels at each side there are six catwalks. The top platform and all of these side catwalks can be reached with the elevators, so men can be taken quickly to any desired height and can then walk forward or backward to the spot they wish to reach.

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Hydraulically Operated Check Valve Prevents Water-Hammer

By R. A. OSBOURNE
General Electric Company

WATER-HAMMER in pumping-station lines is the result of sudden reversal of water flow in the main when the pumping motor is shut down. This reversal of the water closes a clapper-type valve in the line to prevent flow back through the pump. In doing this the column of water is suddenly stopped with a resulting water hammer.

In cooperation with Henry W. Taylor, consulting engineer, a control has been worked out which he is now putting in operation at the pumping station at Maybrook, N. Y., that prevents water hammer. In this installation there is a hydraulically-operated valve in the main feeder. A three-way solenoid-operated pilot valve controls the hydraulic valve. The remainder of the equipment consists of a motor starter; two voltage relays; one definite-time relay; a limit switch actuated by the solenoid-operated pilot valve, open when the pilot-valve coil is de-energized and closed when it is energized; a hand-off-automatic switch; and a contact-making water-level indicator, either in the form of float switches or similar devices, to indicate electrically high and low water.

The elementary control-circuit diagram will serve to indicate the operation. When the low-level float switch closes, the pump is started through its contact and the normally-closed time-delay opening contact D_1 of the definite-time relay. This relay attempts to establish its own holding circuit but cannot because of the normally-open contact of the relay A actuated by limit switch B being still open. The float switch closing energized coil C on the starter and closes contacts C_1 and C_2. When C_2 closes it energizes definite-time relay coil D which closes contact D_2 and establishes its own holding circuit back to the line through the float-switch contact. Coil E is also energized by the same circuit and closes the pilot-valve coil supplying water for the hydraulically-operated main valve that opens the line from the pump to the tank. Energizing the pilot-valve coil closes limit switch B and puts power on relay coil A, which closes contact A_1 and opens A_2 and drops out time relay D and establishes the holding circuit of starter coils C through A_1 and C_1, so that when the float-switch contacts indicating low level, have broken contact, the motor will continue to run.

When the high level-float indicates a full tank, the pilot-valve circuit is broken, causing the coil to be de-

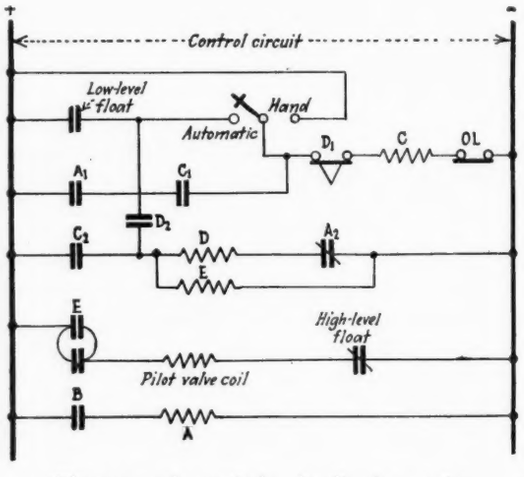

Diagram of control circuit for automatically starting a pump with a hydraulically-operated check valve

energized. This valve because of its three-way construction reverses the operation of a hydraulically-operated main-line valve causing it to close while the motor is still in operation. When the main valve reaches the end of its down stroke, limit switch B opens and cuts power off from coil A. When contact A_1 opens it releases starter coil C and stops the motor. The valve having been closed with pressure still on the pipe line from the pump, no reversal in the flow takes place, consequently there can be no water hammer. The time relay D is included to shut down the pump after a definite time if for any reason the pilot valve fails to operate.

CURRENT COMMENT

Engineers as Inventors

THE EDITORIAL "Engineers as Inventors" in the Sept. 1 issue of *Power*, and the later letter of Mr. Matthews, seem to offer grounds for discussion.

It is intimated that colleges are somewhat responsible for the failure of all but a limited number of the members of the engineering profession to figure in the archives of the Patent Office as inventors because of tendencies discouraging originality. That suggestion is open to question.

When the educational program of any college, the amount of basic knowledge that a student must acquire and the limited amount of time available during the college year are considered it would seem that neither college nor student has much opportunity for developing originality.

Do we not have to look further afield for the reason behind the paucity of engineers as patentees, rather than credit it to lack of originality? Is it not more likely that the majority of engineers, by reason of their college training, become sufficiently enlightened to realize that the field of invention is hardly worth tilling, under the usual conditions, so do not waste their efforts securing patents which, when all is said and done, will not afford them as much compensation as they would receive in the form of a salary in less time, and with less trouble?

There are two broad fields in which engineers function. In one the engineers are concerned with projects which afford few opportunities for developing anything of a patentable nature. They are concerned chiefly in results obtained by the use of equipment, etc., developed by others, and have little time to devote to anything except the work in hand. From their needs and suggestions have come many of the well-known labor-saving machines, but the patents, justly, went to those who had the time and finances to carry out development. A certain number of the engineers, taking out patents, belong in this group; but the proportion is probably small.

In the other field the engineers are associated with industrial organizations, and are directly employed to bring out improvements in present products, or develop new ideas. In most cases employment carries with it a contract in which the engineer agrees that anything he may develop of a patentable nature is the property of his employer.

I have never heard of an engineer who lost caste because of his inventions; but I have heard of engineers becoming discredited because they became so interested in advancing their own welfare that results their employers could justly expect were not produced, which is quite another matter.

A number of years ago the writer heard that behind the growth and prosperity of a certain industrial organization was a system whereby every employee was, in effect, a free-lance inventor. All were urged to submit suggestions as to improvements in new or existing products, to a committee representing not only the management, but the employees.

The suggestor of an acceptable idea of a non-patentable nature received a cash award commensurate with the value of the idea to the management. If an idea had patent possibilities, he was given opportunity, and such aid as was necessary, to develop it.

If a patent resulted it was in the name of the inventor, but assigned by agreement to the company. The inventor received a cash reward, and, in addition, a royalty as long as his patent proved to be profitable, regardless of whether he continued as an employee.

It would be interesting to know if such a system has been adopted to any extent, how it works, and how much the producers of ideas have profited. Perhaps some of the readers of *Power* may be in position to furnish further information.

In any case the records of the Patent Office carry no true indication as to the originality of engineers. I believe the colleges have very little to do with it.

Wollaston, Mass. C. M. DURGIN.

Reducing Power Consumption of Magnetic Contactor Coil

THE STORY of a poorly designed contactor coil by Thomas C. Miller, on page 136, July 28 number, is interesting. It is well known that a coil made with other than heat-resisting insulation should not attain a temperature exceeding 105 deg. C. To meet this requirement the temperature of the coil's surface must be less than this limiting value. The manufacturer therefore erred when a temperature equal to that of an electric iron was approved.

Relative to the difficulty in counting the number of turns in the defective coils, this could have been overcome by taping the coil and then cutting through both sides with a hacksaw, thus presenting an end view of each conductor.

The current taken by alternating-current magnets is fixed by reactance, instead of resistance, as for direct-current types. The pull of an alternating-current magnet is affected but little by an increase in temperature, and the accompanying increase in coil resistance. The losses in an alternating-current contactor are large, due to the shading coil and to rivets or other thick parts generally forming part of the core. The current will be greatly increased by a relatively small air gap. When the armature is open the contactor's current will be 3.5 to 5.0 times normal.

The following values were obtained from a test made on a 220-volt, 10-hp., 3-pole contactor. The area of the pole-faces was 0.31 square inch.

Armature	Volts	Amp.	Watts	App., Watts	Power Factor	Pull, Lb.
Closed	235	0.26	21	61	0.34	10
Armature Open	235	0.94	51	221	0.23	0.19

From this test it is clear that the power factor of an alternating-current contactor is low. Assuming a conservative value of 0.40, the power saving in Mr. Miller's magnet coil would be 0.964 instead of 2.41 kw.

If conditions beyond control result in a maximum coil temperature approaching 105 deg. C., the use of asbestos insulation is recommended. A coil of asbestos-insulated wire and taped with asbestos tape will safely withstand a temperature of 150 deg. C. continuously and 260 deg. C. intermittently. RAY BARR GLEN.

Oakland, Calif.

The Cost of Free Engineering

Do WE EVER get anything for nothing? If so, is it the thing we want?

Awhile back, a manufacturing executive was telling me about the purchase of some new equipment for his plant. He particularly spoke of the generosity of the company which had supplied it, and how it had gratuitously sent engineers down to make a preliminary study of conditions. Although competitive prices were obtained from other firms, he finally bought from this "free engineering" firm at a higher price than that of the lowest bidder, on an equal-quality basis, because the company had been so "nice."

I have no quarrel with this man because he bought the higher-priced equipment and got the engineering free, as he stated—and I sincerely believe he thought he did—nor have I with the manufacturer who furnished it and got the extra price, except for the camouflaged way in which it was done, and the palpable unfairness to those other manufacturers who did not furnish engineering free but who were asked to bid after the cards were stacked.

Another occurrence just past concerns the plant of a manufacturer who expects "free engineering." When he moved into another building a few years ago all of his engineering was done for him by the power contractor. The manufacturer of this product requires a lot of process steam, and considerable electric power. A short time ago the manufacturer awoke to the fact that it was costing him too much money. With purchased electric power, over 50 per cent of the bill was in demand charge. He then started to consider an engine.

Except for some few industries, a demand charge of 50 per cent of the power bill should indicate something wrong in the layout or in plant operation. It is a safe assumption for this particular plant that an experienced engineer could have materially changed the conditions that were causing the high demand charge.

This evil of "free engineering" is not confined to manufacturers alone. There are just as many engineers who are doing the same thing at times. They think that by furnishing the prospect with a free engineering sample they are going to get his job. Sometimes they do; more often not. And in any event the overhead is greater, so that the price for the service frequently defeats the original idea, that is, to sell a client a service he needs at a price that will be attractive. Business is as bad in engineering as in other lines, but giving it away will not make it any better.

As to whether engineering, in the sense used here, can ever be considered "free" is an open question. Rather than a definition of the term itself, what is needed is a more definitely recognized point at which engineering as a justifiable service adjunct of product selling should stop.

There is no reason why Mr. A, who manufactures certain equipment requiring technical application, should not offer Mr. B, who wants to buy it, the engineering service necessary to plan the installation. In fact, he will probably have a hard time these days to sell it if he does not. If Mr. B does not have his own engineering force to do it, more than likely it will not accomplish the results Mr. B expected. However, this service should not be called "free engineering." It isn't. Mr. B. is paying for it, since it is part of the overhead that Mr. A includes in the selling price of his equipment. In so far as this engineering service is necessary to insure the proper application of the equipment, it is probably justified. That its cost is included as a legitimate part of the selling price should, however, be understood by both parties.

If Mr. A goes to Mr. B, solicited or unsolicited, and interests him in his product, tells him he will make a survey of his plant conditions free of charge, and, knowingly or otherwise, sells him his product when what Mr. B really needs is something entirely different, the transaction borders on the dishonest. Dishonest if he sold him what he did not need; still more dishonest if, under the guise of "free engineering," he sold him the idea that he was going to give him something that he was not competent to supply.

Such a transaction not only hurts the buyer and the seller, it injures all legitimate manufacturers and engineers.

The question is frequently raised as to how far such engineering by the manufacturer should go in replacing the services of the independent engineer.

Manufacturers complain that they have to furnish most of the data that engineers use. Why not? They should be specialists in the line of their product. The engineer, and particularly the one in general practice, may or may not be specialized along the same line, as his field is ordinarily much broader. The very multiplicity of the materials and equipment with which he has to deal usually precludes this special knowledge. To offset this he does have the broader vision of the problem in hand, and usually in heart, as he is not concerned with one particular piece of equipment but rather with the correlation of all parts to the benefit of the whole. He must needs go to the manufacturer for the details, and at times call in the specialist.

Whether the engineering is done by the manufacturer or by the independent consultant, the buyer should understand that he is paying for it. His only concern should be, which plan will most economically serve his best interests.

R. M. FULLER.

Riverton, N. J.

Largest-Diameter Hydro Turbines For Plant in Sweden

I AM much interested in the reference in your Sept. 8 number to the Vargön hydro-electric station now being built in South Sweden. As associates of A. B. Verkstaden, Kristinehamn, I desire to point out that full responsibility for the output and efficiencies of both turbines is carried by our associates, from whom one complete turbine and one complete runner for the second turbine have been ordered.

Regarding the arrangement with a closed turbine pit under vacuum, this has been used in Europe for both large and small size installations and to a greater extent than the article would indicate. Such installations have been made in England and India with runners 5 and 6 ft. in diameter, which must be considered other than small even in these days.

The article does not make entirely clear that it is the runners of Vargön, which are 26 ft. 3 in. diameter, thus making these turbines the largest in physical dimensions ever built, whether of Kaplan or any other type.

E. N. WEBB,
Engineer and Manager for India,
London, England. Boving & Company, Ltd.

"Power and the Public" Discussed by Political Academy in Philadelphia

Economic aspects of power issue stressed by speakers for both sides of the question. Topics included holding companies, rates, federal and state regulation, ownership, valuation and future growth

AN OPEN FORUM on the general topic "Power and the Public" was held by the Academy of Political and Social Science in Philadelphia, Pa., on Nov. 6 and 7. Both sides of the issue were presented at six sessions, each of which was devoted to one of the following subjects: "Field and Function of the Holding Company"; "Rates—Domestic, Commercial and Power"; "Regulation: Federal and State"; "Valuation"; "Public or Private Ownership"; and "Our Electrical Future." Economic aspects were emphasized by the speakers.

Opening the first session, Dr. James C. Bonbright, professor of finance at Columbia University, launched an attack on the holding company system. "Although the electricity business has long been regarded as essentially local, the entire power industry has come to be dominated by ten or twelve great systems of holding companies," he declared.

"These companies are not now recognized by the courts as public utility companies, and thus escape regulation by the state public service commissions. Regulation of public utility companies will never be effective as long as holding companies escape supervision.

Service Charges Denounced

"One of the greatest evils of the holding company system is service charges for all sorts of services to prevent reduction in rates to consumers. In my opinion, the whole practice of utility companies trading with themselves to make profitable transactions for the holding companies is essentially vicious. Its persistence for many years and defense by a great majority of present-day executives is not a high testimonial to our current business ethics."

Dr. Bonbright offered four main points for reform of present public-utility evils: Revision of state public-service laws; rational plans for consolidation of utilities; abolition of inter-company transactions for profit, and regulation of holding-company securities.

Concluding, he termed federal regulation, in cooperation with the states, "the only way to control utilities."

John T. Flynn of New York City, a noted writer on economic subjects, believed "there is nothing wrong with a holding company which serves to tie in operating companies and give them efficient advice, but the pyramided structure of holding companies holding other holding companies, and themselves in turn being held by others, should be wiped out." Business men seeking a change in the Sherman anti-trust law, he warned, can expect little aid from Congress as long as the present system of pyramiding holding companies continues.

In outlining the position of the holding-company executives, W. H. Hodge, vice-president of the Byllesby Engineering and Management Corporation, Chicago, said he agreed with Dr. Bonbright as to federal regulation of a sort, so long as it were confined to the four points outlined in the professor's address. "Federal utility regulation of a kind is possible," he declared, "but it would tend to impair efficiency and initiative, cause friction between the federal regulating body and the various states, and put the power industry under bureaucratic domination if not limited in some measure."

Attacks Rate Critics

Strongly attacking rate critics as "usually reluctant to face facts as to costs because the facts do not support their charges," Edwin Gruhl, vice-president and general manager of The North American Company, New York City, opened the second session on domestic, commercial and power rates. He defended present rate structures as economically sound, denied that there was any "mystery" about distribution costs, except what critics introduced themselves, and denounced any form of public ownership.

The public utility managements, the speaker said, are more interested than anyone else in rate schedules which do not discriminate.

"Such a price policy," he said, "has resulted in lower costs and cheaper rates. It has resulted in a wider distribution of the benefits of electric service in the United States as reflected by our higher wages and better living conditions than any other country in the world."

W. S. Lee, president of the W. S. Lee Engineering Corporation, Charlotte, N. C., had a paper prepared to answer criticism on the differences in rates for the various power-using groups, but he gave over his time to Mr. Gruhl. He added extemporaneously in reply to those who held the low Canadian power rate should be an example for the United States, that construction costs in Canada are 60 per cent lower than in the United States.

Harold Evans, former member of the Pennsylvania Public Service Commission, said that domestic rates for electricity average 4.25 times higher than average wholesale rates, 6.5 times higher than average railway rates and 4.4 times higher than the two together.

He declared this "spread" excessive. He urged that the companies would profit greatly by lowering domestic rates and increasing use of appliances thereby, and hence total sales of current.

Mr. Evans said there had been no serious reduction in rates in 25 years, but that the extended use of electrical appliances had brought people to use enough electricity to give them the benefit of the lower rates which go with larger consumption.

Two-Cent Domestic Rate

Leland Olds, the Power Authority of the State of New York, discussed the possibilities of two-cent current for the home, and urged the right of consumers to demand rates of the public utilities as low as municipalities themselves could produce power in publicly owned plants.

"The two-cent kilowatt-hour is coming," he said, "just as soon as the power executives are made to realize that high domestic consumption will be the immediate result of low price."

Offering figures showing the benefits that two-cent electricty would bring the power industry, Mr. Olds revealed that the average annual bill for domestic consumption under a two-cent rate would likely increase from the present $34.50 a year to $60.

Furthermore, he pointed out, an exhaustive comparison of the cost of power in Montreal, Toronto and Winnipeg, with costs of similar service in 15 large American cities shows that the Canadian cost is approximately half of that in the United States.

At the session on utility regulation, Governor Gifford Pinchot, of Pennsylvania, and Col. William J. Donovan, former Assistant Attorney-General of the United States, debated the question of federal or state control.

Colonel Donovan urged that regulation be left to the states, on the ground that "one of the fundamental principles of our government is that local problems can best be dealt with by locally constituted authorities readily accessible to the public they serve and most familiar with the problems involved."

He said while 13 to 20 per cent of the power produced in central stations is transmitted across state lines, only 4 or 5 per cent is "sold by a generating company in one state to a distributing

company in another state." He maintained that a state has power to inquire into costs and that a state commission has the right to "refuse to approve a contract which was improvidently entered into and which called for the payment of excessive charges by the local company."

Watering of securities by holding companies could be dealt with, he declared, by the states individually, under "blue sky" legislation and by control over issuance of securities of the operating companies.

He suggested that by mutual legislation states could honor the process of subpoena issued by another state, thus facilitating the obtaining of evidence in public utility cases. He suggested also that in matters regional rather than local in their nature the states concerned can undertake by agreement to deal collectively. He cited the use of this "compact" method in settling Boulder Dam relations of the states.

Urges Federal Regulation

Federal regulation was declared by Governor Pinchot indispensable because of the interstate nature of the modern power industry. He predicted that state regulation will be aided and not hindered by federal activity in such interstate problems.

He said that while interstate energy in 1929 totaled 17.57 per cent, Pennsylvania imports 25.88 per cent of the energy it consumes and New Jersey 26.12 per cent.

Urging federal regulation in the interstate power field, Governor Pinchot declared that "one of the main problems is to reach beyond the operating companies to the corporations which hold, own and control them; because of the nation-wide character of industrial control this cannot be done by individual state commissions, nor by state compacts—it can be done, and can be done only, by the federal government supplementing the powers of the states. More than that, it should be done, and done soon."

He declared the "state-compact" method proposed by Colonel Donovan ineffective and intolerably slow.

Valuation in Minor Rôle

In opening the discussion on valuation, ex-Judge William L. Ransom, of the New York Bar, stated that observation and experience had led him to believe the so-called "valuation controversy" had lost a good deal of its vigor and vitality. The question of rate regulation, he believed, is much more a question of the capability of state commissions than of any rate theory.

"No governor or legislative leader," declared Judge Ransom, "has a right or reason, in my judgment, to lament or denounce any insufficiencies of state regulation until he has brought it about that the commissions are equipped with competent and independent staffs, adequate in size and sufficiently well-paid to attract and hold men and women of first-grade ability and to make everyone therein feel that the public service offers a permanent career at compensation sufficiently attractive to exclude the idea that transfer to company payrolls must be an early objective.

"The fact stands out that in the states where regulation is adequately staffed, 99 per cent of the statutory duties of the commissions is discharged diligently, competently, and broad-mindedly in the public interest. Rarely does the performance of the great bulk of the commission's work figure at all in political or public controversies. A negligible fraction of what such a commission does or fails to do is ever discussed in the political arena."

Henry C. Attwill, chairman of the Massachusetts Department of Public Utilities, agreed with Judge Ransom as to the minor part valuation plays in regulation of public utilities, and gave six reasons why he objected to any system of regulation based on valuation of property: (1) It slows up regulation and in a great measure makes it ineffective. (2) It is costly in administration and its cost cannot be justified by the results. (3) It includes the depreciation reserve as a basis of the return and thereby builds up hostility between consumer and stockholder. (4) It leads to valuations by courts, which are nearly always too high. (5) It substitutes the judgment of a court-appointed master for that of the state commission. (6) It is an incentive to inefficiency.

Massachusetts Method

Mr. Attwill declared that the aim of regulation is to secure for the public the most efficient and economical service obtainable, consistent with fair treatment of those who furnish the capital. He maintained that adequate justice can be done to the public and to the utilities through the Massachusetts method of supervising the issuance of securities and permitting the companies to charge rates that will enable them to pay a fair return upon the capital prudently invested. This system, he said, has been in operation nearly 50 years "and resort to the federal courts in all that time has been sought by electric companies but twice, both being abandoned."

Outlining the power situation in England, Richard Joyce Smith, assistant professor of law at Yale University, stated that there was no valuation problem there, due to the fortunate provisions of the electricty acts. The situation in this country might have been different, he said, if the Fourteenth Amendment, originally adopted for the protection of the Negro, had not become the chief benefactor of the public utilities under "the unfortunate decision of the Supreme Court in the Smythe vs. Ames case."

Chester I. Hall, president of the Hall Electric Heating Company, traced the growth of the electrical age and stressed the increasing importance of the domestic load. Looking toward the future, Mr. Hall's advice was to burn more fuel in the factory and let electricity work more hours a day in the home.

A plan providing for government ownership and operation of public utilities in place of the present system of private ownership under government regulation, which results in a "divided responsibility," was proposed by Joseph B. Eastman, member of the Interstate Commerce Commission, speaking at the session on ownership.

Public Ownership Plan

"Public ownership," said Mr. Eastman, "need not be combined with public operation. It is quite possible to contract for private management, and to provide in the contract such definite safeguards against exploitation and abuse as may be desired. Personally I incline toward public operation as well as ownership. But such operation need not be through an ordinary government department or bureau. Instead it can, and I believe should be, carried on, just as private operation is carried on, through the medium of a separate corporation, with the government as the stockholder."

He said that the time is not yet "ripe," but that public opinion is inclining more and more toward government ownership. Such a system, he explained, would "at one stroke, eliminate the troublesome question of valuation, greatly simplify financing, largely eliminate the courts as a time-consuming factor in the situation, and reduce cumbersome judicial procedure in connection with questions of management to a minimum."

In conclusion Commissioner Eastman challenged the tenet held by many that the desire for financial gain is the only motive impelling men to their best endeavors. "My very profound belief," he said, "is that the best things which have been done in the world have been impelled by higher motives than the desire for financial gain."

Profit Motive Essential

Samuel Ferguson, president of the Hartford Electric Light Company, replied to Commissioner Eastman by a categorical denial that public ownership would accomplish the benefits it is claimed would follow its administration of the utilities.

Profits to the private companies is so small that public ownership would not result in material rate reductions, he said. Removal of taxes from the utilities would merely result in a shifting of the tax burden which would essentially remain the same, and high salaries paid to private executives have resulted in better service than is obtained through low salaried public servants, he argued.

Removal of the profit motive would mean the end of initiative and decrease efficiency, he said.

Discussing ownership and regulation of electric utilities in Great Britain, Orren C. Hormell, professor of government at Bowdoin College, said good results had been obtained there through a working agreement between government agencies and private capital. The British believe, Professor Hormell said,

"that through such combination and co-operation leadership is being created which will be competent to forecast demands and effectively adjust productive capacity to potential consumption."

"This country, wealthy and powerful as it is, could not take over and operate the electric utilities on any basis of sound business," declared Matthew S. Sloan, president of the New York Edison Company, at the session on "Our Electrical Future."

The greater part of Mr. Sloan's address was devoted to the development of electrical service to the community through technical advances and the evolution of small operating companies into larger units through merger in order to enable the industry to give efficient and economical service. "The small company could not do the job," he said. "It has not the resources—technical, physical, financial—to supply the type of service necessary and proper to develop its market. It could not get them."

Future of Power

In conclusion Mr. Sloan said, "I look forward to a future in which the electric utilities will develop and grow as businesses, remaining prosperous as they earn and deserve prosperity by increased usefulness to people and communities. I look forward to a future in which the relations between this business and government agencies dealing with it will become more clearly defined and better adapted to furthering the well-being both of companies and customers—a future of laws and administration of laws based increasingly on sound economics rather than on political opportunism, despite the extremists on both sides of the so-called utility issue. I look ahead to a time, not too remote, when electricity will come close to being what it is now sometimes called, mankind's universal servant."

The last speaker of the meeting, Donald R. Richberg, general counsel of the National Conference on Valuation of Railroads, bitterly denounced the inequalities in income under the present industrial system; charged that bankers, utility owners and manufacturers in the last three years divided the largest profits of history, while at the same time the total wages of workers declined; and declared that the mal-distribution of wealth will grow worse in the future development of electric power along its present course.

Denying he was a protagonist of public ownership, Mr. Richberg declared the time is here when all essential industries must accept a definite social responsibility and be subject to some measure of effective control in the interest of consumer and worker.

"The future of electrical power and the public," he said, "is bound up in the future relations of man power and money power. It is dependent on the solution of that great problem of developing the social power necessary to control and utilize those superhuman physical powers now available to mankind."

The Development of the Steam Turbine in Recent Years

By PROF.-DR. WEWERKA
Stuttgart

THE DEVELOPMENT of the steam turbine since 1923 has been very rapid. One might almost say too rapid. That year witnessed the beginning of considerable increases in pressure and temperature, as well as in capacity of units. At the same time efforts were made to improve the heat utilization in medium-sized and large turbines through the use of a larger number of stages. In small turbines the same effect was obtained by increasing the speed.

Increases in steam pressures alone would have caused little or no difficulty in turbines. Such difficulties as did occur could be overcome or materially diminished by structural design changes and by increasing the number of stages, or by increasing the speed. Constructional difficulties due to high pressure had already been overcome in connection with air and gas compressors and hydraulic machinery and the experience gained could be readily transferred.

Increase in the working steam temperature to 750 deg. F., however, was much more serious. As regards this aspect of the development, there can be no doubt that it proceeded too quickly in Germany. The non-German countries, more particularly the United States, usually in the van of progress, have been much more cautious in this respect and have advanced more slowly. At first sight it would seem that the relatively slight increase in steam temperature from 660 to 750 deg. F. would have very little effect on steam turbine construction. In the old steam turbine, fitted with a small number of stages, the temperature of the steam in the first chamber, and in the high-pressure packing, was about 480 deg. F., at a pressure of 60 to 70 lb. per square inch. In the higher-pressure, multi-stage turbine, however, temperatures were raised to 700 or 735 deg. F. at pressures ranging from 280 to 350 lb. per square inch.

The attempts to adapt the existing types of design and materials by slight modifications to these higher pressures and temperatures proved unsuccessful. This was due to the radical change in tensile strength and yield point of the metals used under these higher temperatures. Improvements in design and the introduction of new materials, and careful attention to the influence of heat, finally made it possible to overcome these difficulties. The fluctuations in steam temperature, which were considerable at first, and which were more troublesome than the higher degrees of temperature in themselves, have been eliminated by the automatic adjustment of the superheating of the steam.

Since 1923 the maximum capacity of turbine sets, operating condensing, turned out in Germany, has gone up from about 14,000 kw. to more than 20,000 kw. at 3,000 r.p.m. At 1,500 r.p.m. the maximum capacity has risen from 25,000 to 85,000 kw. An increase in the maximum capacity of the machine is possible only by increasing the steam quantity as well as the peripheral velocity of the last stages. In small turbines the maximum capacity can be increased by increasing the speed to 6,000 or 8,000 r.p.m.

Increase in the number of stages for turbines operating condensing has resulted in an increase in the moisture content of the steam in the last stages. This has caused trouble by the erosion of the lower-stage blading, the bronze and nickel-steel blading material formerly used failing rapidly. Monel-metal and rustproof steel are now used and give more satisfactory results.

The enormous increase in unit capacity of recent years, a development in which German turbine manufacturers occupy a leading position, has had for its main object the reduction of price and of space requirements. The improvement in heat utilization of such units has been slight. A material cheapening of price, together with a notable improvement in efficiency, has been effected, however, in small capacity turbines, partly by increasing the speed and partly by re-introducing geared turbines.

Multi-stage back-pressure turbines, built for high initial steam pressures and temperatures, and for relatively small capacities, are being built and used to supply power and exhaust steam to industrial plants. At present about half of the turbines built in Germany every year are of this type. Such turbines are being built for capacities as low as 200 to 500 kw. Geared turbines, operating condensing, are also being built up to capacities of 2,000 kw. Turbines are also being adapted to use with steam accumulators and interstage superheaters.

Notwithstanding the great progress made in the construction of steam turbines during recent years, little advance has been made in theoretical knowledge. Neither the laboratories attached to steam-turbine manufacturing works nor those in technical colleges have added much to the present knowledge. The numerous practical difficulties connected with the construction of steam turbines clearly prove the need for thorough, systematic laboratory investigation. Experience has shown that any money spent for such purposes is a paying investment, and that a far larger expenditure results when the difficulties are worked out in actual practice.

Abstracted from the *Borsig Technical Review*, August, 1931.

READERS' PROBLEMS

Conducted by L. H. MORRISON

SAVING WITH FUEL OIL—*What would be the saving per year through using oil in place of coal, using the following data: 1,400 tons of 13,500-B.t.u. coal yearly at $6.59 per ton; two horizontal return tubular boilers, 6x18 ft.; grate surface, 36 sq.ft.; height from grate to boiler, 5 ft.; natural draft; hand firing. It is intended to use rotary oil burners, fuel oil, 12 to 8 Baumé, with 152,400 B.t.u. per gallon.* J.S.C.

The data presented are insufficient to allow the making of an accurate comparison between the two fuels. If the following assumptions are considered to be approximately correct, the saving in fuel cost, due to the use of oil, rather than coal, would appear to be about $1,000 per year.

You state the present coal usage to be 1,400 tons per year at a delivered price of $6.59. The yearly fuel bill is $9,220 under present conditions. Assuming an average efficiency of 65 per cent of these boilers, the equivalent evaporation would be 8.8 lb. of steam per pound of coal, and the pounds of steam produced in the year would be 24,650,000.

You state the oil as being an average of 152,400 B.t.u. per gallon. This is about 19,000 B.t.u. per pound of oil, and this oil will probably run about 338 lb. per barrel. Assuming an average efficiency of 74 per cent with oil in these boilers, the equivalent evaporation would be 14 lb. of steam per pound of oil. On this basis the pounds of steam per year, given above, would require 1,760,000 lb. of oil, or 5,200 bbl. You make no mention of the price, delivered, of this oil, but assuming a price of $1.50 a barrel the yearly fuel bill would be $7,800. On the basis of the cost of the oil alone, a saving of $1,420 would be possible over the present cost when using coal.

Unless the oil-handling and burning equipment is already installed, however, an additional cost will be incurred when using oil, due to the necessity of purchasing the additional oil-burning equipment. The cost of oil-firing equipment, including burners, pumps, heaters and a storage tank, would probably amount to about $2,500. At 15 per cent per year, the yearly fixed charges on this investment would amount to $375. Adding this to the fuel cost of $7,800 gives a total cost, when using oil, of $8,175. Thus the saving resulting from the use of oil under the above assumed conditions would amount to only $1,045.

In addition to the above, certain savings in the cost of operating, labor and ash removal would be possible with fuel oil. With the higher furnace temperatures possible with oil, however, it is probable that the cost of maintaining the boiler and furnace would increase sufficiently to counterbalance any saving in labor and ash handling.

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MOISTURE IN COMPRESSOR DISCHARGE—*Why does the receiver in our air compressor discharge line fill with water. Does this indicate a cracked cylinder jacket?* J.S.

The moisture is part of the water vapor in the air drawn into the compressor which has settled out after compression. For example, each cubic foot of air drawn into the cylinder contains a weight of water vapor depending upon the condition of the air. The air is crowded by compression into a smaller volume, and as only a definite weight of air can be contained in each cubic foot of air at a set temperature, obviously the reduction in the volume of air after compression and cooling will cause some of the water vapor to condense and settle in the receiver.

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FREEZING TEMPERATURE AT HIGH ALTITUDES—*What is the effect of altitude on the freezing point of water; more particularly what is the freezing temperature at 10,000 ft. above sea level?* M.B.S.

While a pressure change does influence the freezing point, this is evident at high pressure only. The influence of the pressure drop due to 10,000 ft. elevation will be so small that the change in freezing temperature cannot be measured by any ordinary temperature indicator.

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Deconcentrator Vs. Continuous Blowdown

. . Summary of Readers' Opinions on the Previous Question . .

IN MY power plant I have a 2,500-sq.ft. boiler using soft water run at ratings up to 200 per cent. In order to keep the concentration down it is necessary to have a continuous blow from the surface of the boiler through a ¾-in. orifice. I have contemplated putting in either a continuous blow or a deconcentrator. The temperature of the water going into the water heater about 7 months of the year averages 50, the other 5 months about 80 deg. F. The deconcentrator manufacturers hold out the advantage of a minimum amount of blowdown, while the continuous-blowdown makers claim its advantage as being the transfer of heat from the blowdown of water to the feed water. In my particular case the advantages of the continuous blowdown is very small. C.F.F.

THIS question brings up a subject about which uncertainty seems to prevail generally. Yet it is one which plays an important part in determining water-conditioning costs, freedom from wet steam and boiler embrittlement.

"Concentration balances" of a boiler, according to D. E. Lowman, Elgin Softener Corporation is the basic factor which determines the required type of concentration-control equipment. How, then, can the concentration balance be best maintained? How is it affected by the water treatment employed; and how does the treatment used determine the choice of sludge deconcentrator or continuous blowdown?

The sludge deconcentrator is a separation process whereby suspended matter, sludge and mud are separated from the boiler water with a minimum wastage of blowdown. The continuous-blowdown system with heat exchanger, on the other hand, is a dilution process whereby a definite quantity of blowdown is removed from the boiler and replaced with fresh incoming feed water.

Sludge deconcentrator apparatus separates the sludge from the boiler water, collecting it in a settling tank located outside the boiler, in a concentrated form, and returning the clarified water to the boiler. The quantity of water wasted in removing the sludge from the deconcentrator is negligible. The results in operation are a clean boiler water (the foundation of the production of clean steam) and elimination of the waste of expensive prepared boiler water.

Mr. Lowman thinks that in converting the mineral content of a boiler water to the soluble sodium salts it is essential to remove a large quantity of blowdown from the boiler if the proper concentration, so necessary to avoid wet steam, is to be maintained. This procedure calls for the continuous-blowdown system with heat exchanger. Many waters are of such composition that the continuous-blowdown method wastes upward of 10 per cent of the make-up water as blowdown. In con-

trast, less than 1 per cent would be lost as blowdown by the sludge deconcentrator, providing the water had been conditioned correctly.

The amount of water which must be blown down, counters J. I. Hudson, Nashville, Tenn., is not determined by the method of blowing down but depends entirely on the rate of steaming, the salt concentration of the feed water and the desired salt concentration of the water in the boiler. The amount of heat recovered from the blowdown water, however, does depend on the kind of equipment installed with the blowdown system.

When a flash tank precedes a heat exchanger a certain amount of the blowdown water flashes into steam and mixes directly with the feed water. This amount depends on pressure conditions in the boiler and the feed-water heater. Citing as an example a boiler pressure of 175 lb. and a feed-water heater heater pressure of 10 lb., Mr. Hudson states that about 15 per cent of the blowdown water reenters the system in this manner. A slightly greater amount of heat is recovered with this system than when heat exchangers are used alone. When heat exchangers alone are used it is possible to increase the temperature of the boiler-feed water 5 or 10 deg. F. above the maximum temperature possible with exhaust-steam heating. Where there is a surplus of exhaust steam this is a decided advantage. Under these conditions an increase of 10 deg. F. in the temperature of the feed water results in a fuel saving of approximately 1 per cent.

In opposition is the position taken by R. E. Summers, assistant professor of mechanical engineering, Oregon State Agricultural College, who states that when an excess of hot feed water is available it is doubtful if heat exchange in the blowdown system is often justifiable.

It is Mr. Loman's opinion that problems involving, primarily, sludge-producing matter require a sludge deconcentrator. Problems involving soluble salts call for the use of the continuous-blowdown system with heat exchanger.

The most economical procedure is to remove sludge, mud and suspended matter. Consequently the correct method for conditioning the water produces the maximum quantity of suspended solids and a minimum quantity of soluble sodium salts.

It is obvious, then, that the selection of the method of softening and conditioning the boiler water establishes the type of concentration which must be controlled. In selecting a method of treatment or softening, it is desirable to choose one which will produce the maximum quantity of sludge in preference to soluble sodium salts.

The first step in the problem of selecting concentration control equipment is to secure a careful water survey. This water survey should include: (1) general analysis of the raw water, (2) feed water from the heater and (3) the concentrated boiler water from the individual boilers.

A survey of this character will immediately disclose the method of softening or conditioning that will minimize the sodium salts as well as the type of concentration-control equipment necessary to establish the highest efficiency in steam production.

Based upon the water survey, the method of conditioning can be intelligently selected which will convert the mineral salts in the raw water to sludge with a minimum quantity of sodium salts. If the sludge-producing salts predominate, sludge deconcentrators should be installed. If sodium salts predominate, then the continuous-blowdown system with heat exchanger should be selected.

Elmer H. Anderson, Austin, Minn., is inclined to use the chlorides as the criterion, stating that if chlorides are present in any appreciable quantity a continuous blowdown is usually better, but if chlorides are absent a deconcentrator will give good results.

An exhaustive survey completed during the past several years, says Mr. Lowman, discloses the fact that 65 per cent of the waters found in this country require the sludge deconcentrator, while only 15 per cent require the sludge deconcentrator equipment combined with the heat exchanger, and approximately 20 per cent require the continuous-blowdown system with heat exchanger.

The presence of a large quantity of sodium salts gives rise to another important condition. If the sodium salts include considerable sodium bicarbonate, a severe caustic condition develops within the boiler, involving the potential danger of embrittlement, as well as a tendency to produce wet steam.

Professor Summers is not so certain about the almost universality of application of the deconcentrator. He feels that if the water used is initially soft or is chemically or thermally softened before being fed to the boiler, as the question indicates, there is little to be gained through using a deconcentrator. It is the function of such a device to remove from boiler water suspended scale-forming particles thrown out of solution when hard water is softened in the boiler with heat or chemicals.

It can be assumed, the professor states, that the troubles experienced which either a deconcentrator or a continuous blowdown system might remedy are those of foaming, priming and excessive moisture carryover in steam. There is for any given boiler, with specific feed-water impurities, making steam at any particular rate, a limiting relation between the suspended solid concentration and the dissolved solid concentration that may be permitted if carryover is not to be excessive. Incompletely stated, this relation dictates that when the maximum total solid concentration is encountered the dissolved solid concentration must be low if the suspended solid concentration is to be even appreciable, or vice versa. If the feed water used is soft, it is likely that the greater portion of the blame for carryover can be placed on dissolved solids, such as sodium salts, found in the raw feed-water or introduced therein by chemical softening.

For the majority of dissolved solids in soft water the best remedy is usually found in diluting the solutions in the boiler, that is by increasing the blowdown.

As an afterthought Professor Summers suggests that the so-called mechanical steam purifiers built by a number of companies make possible the carrying of high total boiler-water concentrations with reasonable blowdown rates. In the present case, use of a steam purifier might make the proper course that of simply blowing down rather freely.

The point that impresses E. N. Anderson is the item of wasted exhaust steam, which he believes is the most important and requires attention first. Surely there is some way of reducing this waste and recovering the elusive heat units. Before purchasing equipment for other purposes, he suggests that the problem of utilizing this exhaust steam should be carefully analyzed and the funds available expended toward equipment that will make use of the steam and thereby raise the efficiency level of the plant. Not knowing the source of the excess steam and other essential details of the plant, he offers, no specific recommendation, but mentions a condenser for an engine unit or a closed feed-water heater to be installed betwen the feed pump and the boiler. The temperature of the raw make-up water indicates that considerable steam can be used in raising the temperature of the feed-water to practically the same level as the exhaust steam, in two stages if necessary.

In this he has the support of H. M. Spring, Milford, Del., who thinks that a study of the design of this particular plant would give some practical solution for the use of prevention of excess exhaust steam. Would it not pay, he asks, to purchase enough power in inverse proportion to the demand on the heating system to prevent this loss of exhaust steam?

A Question for Our Readers

WE ARE USING rotative dry vacuum pumps on the condensers of our 2,500-kw. turbines. The best vacuum we can pull is 27 in. even though our cooling water is ample. Our manager suggests that steam-air ejectors would be better. What are the experiences of Power's readers as to the relative merits of the two appliances as vacuum producers, and relative operation costs? A.C.B.

Suitable answers, if received promptly, will be paid for when published

WHAT'S NEW IN PLANT EQUIPMENT

Electric Operator for Elevator-Car Gates

POWER-OPERATED car and hoistway doors are finding an ever-increasing use in elevator service. Even in the small-sized push-button-operated passenger elevators power-operated gates are coming into common use. With this type of elevator, if the gate is hand-operated trouble is experienced with the passengers leaving the gate open after they have used the car. When this occurs the elevator will not respond to buttons pushed on other floors until someone goes to the car and closes the gate. This difficulty is readily overcome by installing an automatic gate operator on the car and connecting its control into that of the elevator so that the gate will open and close automatically. Where dual control is used and an attendant operates the car part of the time an automatic operator on the car gate will open and close it more quickly than can be done by hand and leave the attendant free to open and close the hoistway doors and operate the car. When the car is on automatic control the gate operator will insure the gate's being closed so that the car can respond to the floor button on the landings.

For these and similar applications the gate operator may be of a lighter and simpler construction than required for combination car-gate and landing-door service. A new electric operator for collapsible gates and light-weight sliding car-door panels, that is compact and substantially constructed and light in weight, has been developed by the Elevator Supplies Company, Inc., Hoboken, N. J. This operator consists of a double spur-gear reduction inclosed in an aluminum housing *H*, Fig. 1. At the back of the housing a torque motor *M* is mounted and at the front of the housing is a sector plate *P*, Fig. 2, with a section of internal gear at its top end. The section of spur gear meshes with a pinion on the output shaft of the reduction gear. Two adjustable oil dashpots *D* are arranged to cushion the movement of the car gate or door as it reaches the final closing position in either direction.

The operator is mounted on top of the car, as in Fig. 3, and is connected to the gate by an operating arm *A* and a link arrangement. The gate is shown in the closed position. When the torque motor is started it swings the operating arm to the position *A'*, indicated by the dotted lines. For closing the gate the motor rotates in one direction and to open the gate it turns in the reverse direction.

The control may be arranged for automatic operation so that the gate will open as the car stops at a landing, and after a predetermined interval it will close. The control may also be arranged for push-button operation in the car or at a landing, to close the gate before the car starts. The gate is held in the fully closed position by the operating unit as the car moves up or down the hoistway. Torque motors can be provided for operation on 220-volt, 3-phase, 60-, 50- or 25-cycle current.

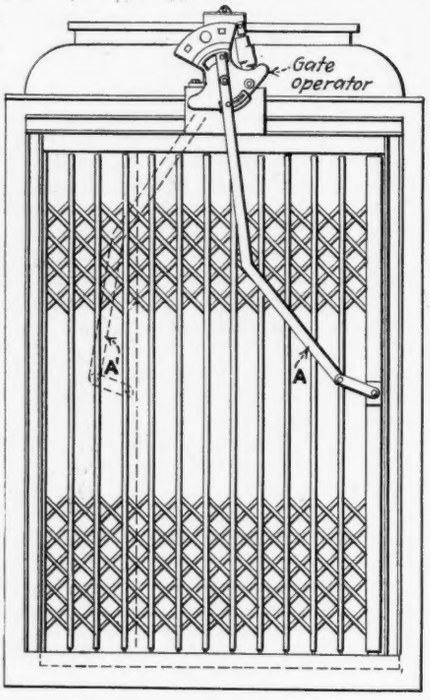


Fig. 3—Gate operator mounted on top of car and connected to car gate

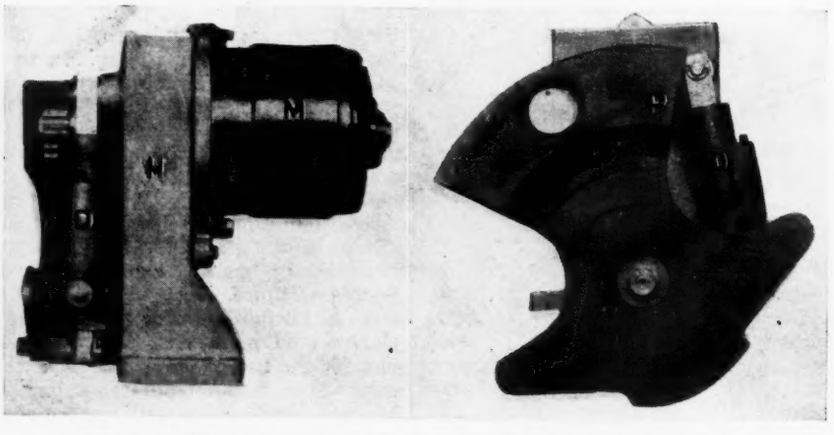
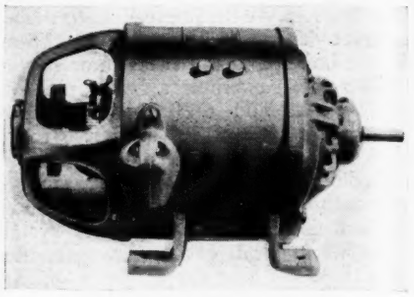


Fig. 1 (Left)—The torque motor is at *M* and the gear housing at *H*

Fig. 2 (Right)—The gate-operating arm connects to sector plate *P*



Motor with refillable-type commutator

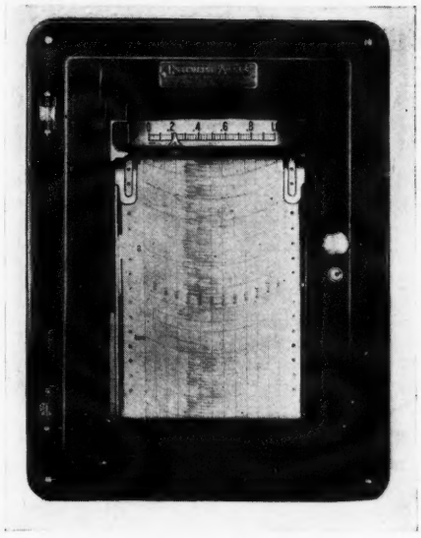
Small Direct-Current Motors

AS A SUPPLEMENT to its larger Type T heavy-duty motors The Reliance Electric & Engineering Company, 1088 Ivanhoe Road, Cleveland, Ohio, has developed a new line of small direct current motors, built in sizes from ½ hp. to 3 hp., 1,750 r.p.m., for constant- or adjustable-speed operation. Like the larger motors, they are provided with ball or sleeve bearings and may be had in either open, semi-inclosed or fully-inclosed construction. The windings are given a finishing coat of bright orange-colored enamel the same as the larger Type T motors, to make it easy to detect and remove dirt.

Another feature is the use of the refillable-type commutator. If the copper bars become damaged or badly worn, they may be easily removed and replaced. Provision is also made for two brushes per stud.

Flush-Type Graphic Instruments in Single and Twin Types

A RECENT addition to the line of graphic instruments put out by the Esterline-Angus Company, Indianapolis, Ind., is the flush-type instrument illustrated. The new instrument is designed to require minimum switchboard space and at the same time give complete and easy access to all the mechanism from the front of the case. It is furnished in single- and twin-type cases. The terminals for connecting to the instrument are mounted in bakelite moldings which extend through openings in the back of the case. The standard mounting for the multiplier is on the back of the



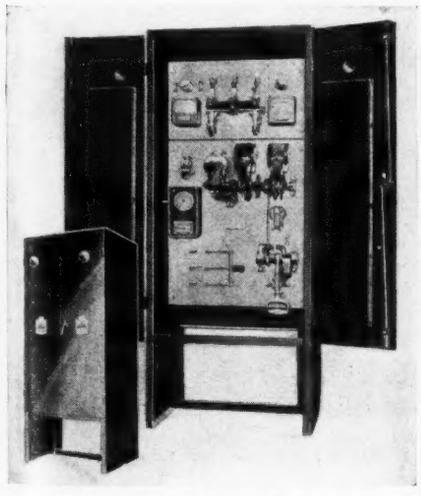
In the single graphic instrument 9 in. of the chart is visible

instrument case, but where specified it can be furnished for separate mounting.

All instruments are furnished with illuminated scales and charts. Either spring clock or Telechron clock chart drive for chart speeds of ¾, 1½, 3, 6 and 12 in. per hour can be furnished. When desired the same type of drive can be furnished to give the same chart speeds per minute or to give chart speeds in inches per second. A quick-grip attachment is available to give extremely high chart speeds for such purposes as studying line disturbances.

Motor Starters for Fire Pump Service

A NEW LINE of alternating-current and direct-current manual, and combined manual and automatic, motor starters for fire pump service includes a type of starter for every application of fire pump equipment. A dustproof and splashproof, floor-type inclosure protects the mechanism and adds materially to the appearance of the installation. This inclosure consists of a heavy angle-iron supporting frame with sheet metal inclosing panels and doors at the front.

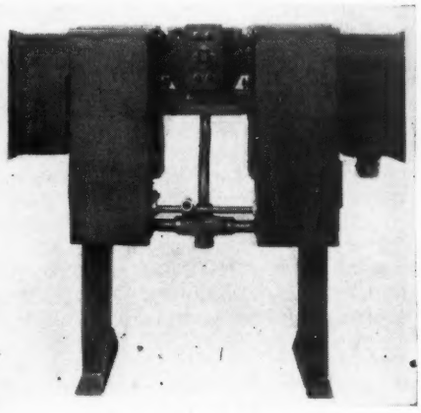


Starter is mounted in floor-type inclosure

Other features include: double-throw main-line knife switch for two sources of power supply; low-voltage protection; circuit breaker overload protection; carbon-to-copper current-carrying contacts; and pilot lights to indicate if the equipment is running or if power is on the line. The combined manual and automatic types are so arranged that should the motor stop because of low voltage the equipment is immediately transferred to automatic operation, and on resumption of voltage the equipment will restart if the pressure is low. The new starters are put out by Cutler-Hammer, Inc., 294 North 12th St., Milwaukee, Wis.

Metal-Clad Switchgear

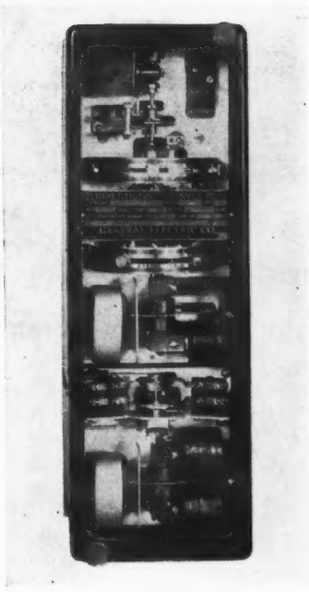
A RECENT development of the Delta-Star Electric Company, Chicago, Ill., is this metal-clad switching unit for power distribution, controlling station auxiliaries, across-the-line motors or similar services. The unit consists of two 600-amp. electrically operated three-pole oil circuit breakers mounted on a steel frame and complete with current transformers and cable compartments. The breakers are mechanically and electrically interlocked so that both cannot be in circuit at the same time. Conveniently mounted on the front is a control panel with switches and indicating lamps. A removable handle is also provided for manual operation.



Metal-clad switching unit

Directional Distance Relay

APPLICABLE to single and parallel transmission lines for rapid protection against phase-to-phase, three-phase and double-ground faults, the directional distance relay, Type GAX, announced by the General Electric Company, Schenectady, N. Y., is a single-phase device comprising a starting, an ohm and a timing unit. The starting unit indicates that there is a fault, the ohm unit indicates where the fault exists, and the timing unit sets the time in which the relay trips the oil circuit breaker which isolates the fault.

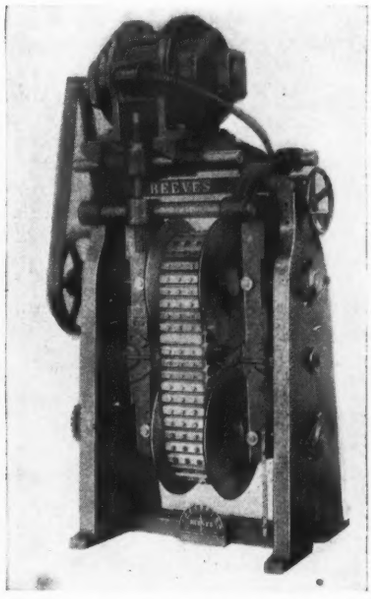


Type GAX directional distance relay

The operating time of the relay depends solely upon the reactance of the line to the fault, which is taken as a direct measurement. It is practically unaffected by the resistance of an arc at the point of the fault.

Vertical Transmission With Pivoting Motor Base

THE VERTICAL Reeves transmission, which is built for requirements of limited floor space by the Reeves Pulley Company, Columbus, Ind., is now available equipped with a motor base which is adjustable vertically, in order that any stretch in the chain or multiple V-belt drive can be taken up. Adjustment is made by a manually operated screw. Lateral adjustment of the motor rails to accommodate different sizes and types of electric motors is also possible.



Vertical transmission with adjustable motor base

NEWS of the FIELD

American Engineering Council Announces Public Works Program to Aid Unemployed

THROUGH the American Engineering Council, the engineering profession has just framed a public works program, which includes all construction of whatever character undertaken by national, state, county and municipal governments and their several sub-divisions as well as that of quasi-governmental bodies. It will be carried out in two divisions by state committees of the council which are now actively at work in all sections of the country.

One division embraces "The Emergency Plan," and the other, "The Future Plan." Owing to existing conditions, it is proposed to concentrate major effort on the former, which, the announcement states, proposes to:

"List all governmental projects authorized and for which appropriations have been made or may be made in the near future.

"Determine the status of each project.

"If the project is being delayed, ascertain the cause or causes thereof.

"If an avoidable delay is due to some governmental agency, present the facts to the governmental official having the authority to remove the cause of the delay, and press immediate action.

"If an unavoidable delay is due to the public or some part thereof, endeavor to reach the responsible party or parties and get action.

"If either case obtains and action is not taken in due time, through publicity acquaint the public with the facts so that public opinion will force action."

The foregoing procedure, through the process of checking and rechecking, is to be continued throughout the emergency, according to the announcement. An immediate countrywide canvass will also be made with the following aims:

"To determine what needed work can be done this winter, such as road and street repairs and construction, removal of traffic hazards, cleaning, repairing and remodeling public and semi-public buildings and grounds and numerous like things, including such larger undertakings as grade-crossings where they may be expeditiously initiated.

"To bring about preparations by engineers and other competent men of plans, specifications, and estimates for each such job.

"To provide necessary means for releasing the work, in cooperation with local officials, relief organizations and prominent citizens."

In outlining the future plan of the Council, the announcement summarized the questions troubling the American people as security of employment, means of wholesomely utilizing leisure time, leveling the business curve, and public developments.

Metropolitan Engineers Organize Relief Unit

MORE THAN 800 engineers in the metropolitan area of New York City attended a mass meeting, held under the auspices of the recently formed Professional Engineers' Committee on Unemployment at the Engineering Societies' Building, Nov. 9, to consider plans for relief to members of the profession who are in need. Sub-committees were appointed to carry forward the activities. Heading these units are George P. Lucas, A.S.M.E., chairman of the Relief Committee; H. A. Kidder, A.I.E.E., chairman of the Finance Committee; and Alfred D. Flynn, Engineering Foundation, chairman of the Clearance Committee, which will coordinate and expedite all activities with other organizations.

Of the 10,000 engineers in the metropolitan area, it was brought out by the speakers, about 2,200 are unemployed. About 60 per cent of these must have help immediately, said Harvey N. Davis, president of Stevens Institute of Technology, while 75 per cent would need help by Jan. 1. He cited a number of pitiful cases of trained engineers who were slowly disintegrating morally and physically as the result of prolonged unemployment.

E. P. Goodrich, a consulting engineer, outlined a plan for "made work," by creating jobs requiring technical skill by municipalities, or in private enterprises.

Niagara-New York Tie-In Approved by Commission

FINAL AUTHORIZATION to complete the interconnection between the steam generating system of the New York Edison Company and the hydro-electric system of the Niagara Hudson Power Corporation was granted Nov. 10 by the Public Service Commission of New York. Construction of the balance of the 110,-

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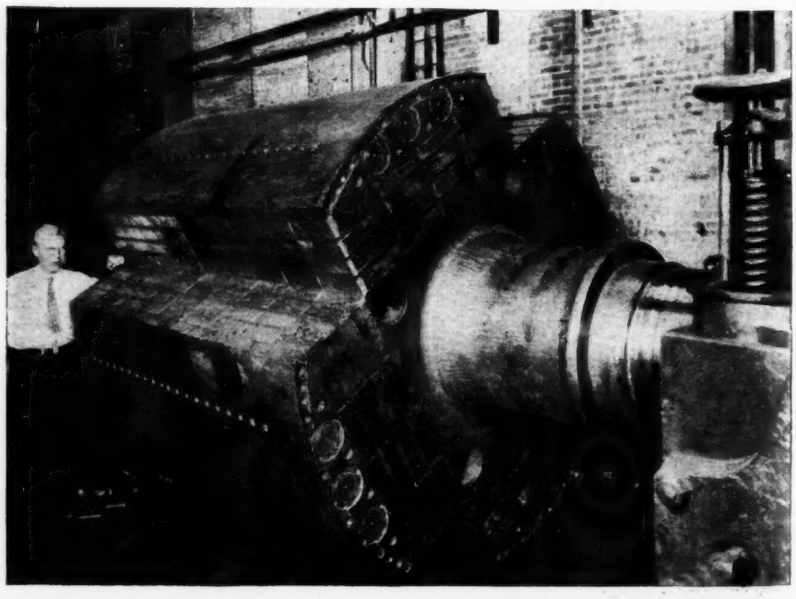


Whirling for nearly a quarter of a century in the Williamsburg power plant of the Brooklyn Edison Company, this rotor of a 750 r.p.m., 10,000 kva. Westinghouse turbine-generator has been returned to the factory to be re-wound. The rotor is 80.5 in. in diameter and is of the pole type. If a drowsy fly had napped on the rotor rim during its 24 years of service, it would have traveled 16,900,000 miles

000-volt line will be started immediately by the New York Power & Light Corporation, a Niagara-Hudson subsidiary, and work will be provided for 1,500 men.

The interconnection, which ties in the Niagara-Hudson Greenbush substation south of Albany with the Edison Dunwoodie substation in Yonkers, has already been built as far as Hudson, about 30 miles from Albany. The remaining section, just authorized, will be 75 miles long and will cost $7,500,000.

When completed the new line will permit sending hydro-electric power from the Niagara-Hudson system to meet peak loads in New York and steam power from the Edison system to supplement upstate plants when low-water conditions prevail. By this means the Edison company expects to save $10,000,000 in plant investment and the Niagara-Hudson company $4,000,000. Operating economies of from $200,000 to $400,000 a year will also be effected, it is estimated.

Approval of the interconnection was originally opposed by the New York Power Authority which contended that the construction of a long distance transmission line hooking up with New York City might seriously interfere with its plans for the sale and distribution of the hydro-electric resources of the St. Lawrence River. This objection was withdrawn, however, after the Niagara-Hudson system had agreed to stipulations designed to protect the aims of the state in developing power at the International Rapids section.

Santa Cruz Upheld in Purchase of Power Unit

RECENT DECISION of the appellate court of California upheld the ruling of the superior court of Santa Cruz that the local city council was within its constitutional rights in making a contract for the purchase of generating equipment.

The City of Santa Cruz pumps its domestic water supply from the gravels of the San Lorenzo River and because it considered the rate it was paying to the Coast Counties Gas & Electric Company for electric pumping excessive, the city council decided to enter into a contract with Fairbanks, Morse & Company, allowing approximately $160,000 for the necessary equipment, under the terms of which Fairbanks, Morse & Company agreed to take its payment from the earnings of the water system. No bonds were issued nor was the indebtedness of the city increased in any way for the purpose.

Five citizens of the community brought suit against the city and Fairbanks, Morse & Company on the ground that the city had not the right to sponsor such a project without the vote of the people. The superior court held that the city council had the right to take the action that it did, because the city charter carries a provision which permits the expenditure of large amounts of money without issuance of bonds when cases of emergency arise.

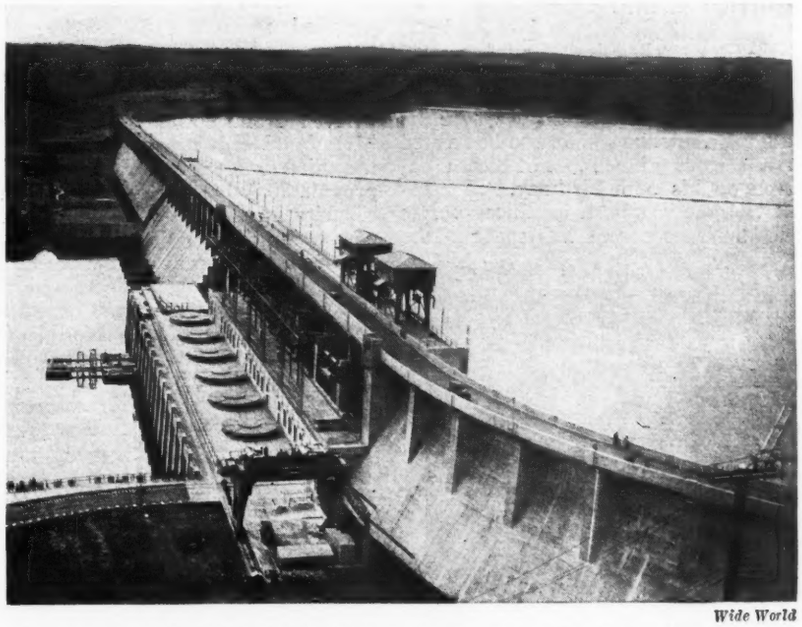
The City of Santa Cruz began operating its new pumping equipment about two years ago, and in connection with the payments, Fairbanks, Morse & Company's attorneys have made the following statement: "The new installation has not only given the utmost satisfaction, but in addition has by its operation to date paid on the cost of its purchase and the cost of installation approximately $94,000 from its earnings without any payments from taxpayers.

Plan Solid CO_2 Plant Using Stack Gases in San Francisco

USING by-product stack gases from Station A of the Pacific Gas and Electric Company as raw material the California Carbonic Ice Company plans to erect a 50-ton solid CO_2 plant in San Francisco, beginning about Jan. 1 and to have the plant in production about Apr. 1. The usual source of CO_2 for manufacturing the solid product has been fermentation or from the burning of coke and the proposed plant will be the first in the West to use by-product gases from a plant burning natural gas.

Four million pounds of CO_2 are said to be avoidable each day. The gas is free from sulfur which simplifies purification. While it contains large amounts of water vapor it is planned to condense this to obtain a distilled water of high purity to be used as boiler make-up water for the power plant.

BAGNELL DAM NOW IN SERVICE



Wide World

Latest view of the $300,000,000 hydro-electric plant of the Union Electric Light Company of St. Louis, on the Osage River near Bagnell, Mo., which went into commercial operation last month, serving St. Louis and the surrounding territory. Constructed by the Stone & Webster Engineering Corporation, the plant develops 268,000 hp. and the dam creates a lake with a shore line of more than 1,400 miles

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Boiler Feedwater Studies Started by Joint Body

THE JOINT RESEARCH COMMITTEE on Boiler Feedwater Studies has recently inaugurated two experimental programs, at Ohio State University and at the University of Michigan. These experimental programs are being conducted under fellowships financed by the committee. Prof. C. W. Foulk at Ohio State is directing the work on priming and foaming characteristics of boiler waters, while a study of the various methods of water analysis is being carried on at the University of Michigan under the direction of Prof. A. H. White.

These programs are especially important to industry in respect to the treatment of water used in high-pressure steam stations. Professor Foulk's work on priming and foaming is already well known and the committee considers it a most valuable study to have continued. The water analysis studies at the University of Michigan will have a direct bearing on the control of embrittlement of boiler steel in reference to the proper conditioning of the water to inhibit such action. Up to the present time there has been much confusion in regard to the analytical methods of water analysis now in use.

The Joint Committee is sponsored by the American Boiler Manufacturers' Association, the American Railway Engineering Association, the American Society for Testing Materials, the American Water Works Association, the N.E.L.A. and A.S.M.E.

Richard T. Crane Dies; Head of Crane Company

RICHARD T. CRANE, president of the Crane Company, Chicago, Ill., died of heart disease on Nov. 7 in the Doctors Hospital, New York City, where he had gone a few days before to be treated for a serious ailment. His death occurred on his 58th birthday.

Mr. Crane was born in Chicago. His entire business career was spent in the

steamfitting and plumbing supplies company, which his father, the late Richard T. Crane, founded in 1855. Mr. Crane was graduated from Yale in 1895, and a year later he entered the works of the Crane Company. He became second vice-president in 1898, and president in 1914.

On becoming president Mr. Crane carried with him the traditions and policies of his father. Those policies and traditions not only incorporated what his business associates described as sound business sense, but a rare regard for the welfare and comfort of the company employees.

Work Started on Additions To San Francisquito Plants

JOBS have been provided for 1,300 men by the Los Angeles Department of Water and Power on construction projects started by the department, according to announcement of H. A. Van Norman, general manager and chief engineer.

For more than a month 1,000 men will be engaged in the work of enlarging the capacity of tunnel lines between power plants 1 and 2 in San Francisquito Canyon to provide water for an additional generating unit in power plant No. 2.

Three hundred men are at work completing the enlargement of the aqueduct capacity to 470 sec.-ft. The first half of this work was done a year ago during October when it was possible to make four shut-offs amounting to 51 days, two shifts of 16 hours carrying through continuously. Funds for this work are supplied from the $38,800,000 water bonds voted in 1930.

Funds for work on the tunnel enlargement between the power plants will be derived from power system revenues, Mr. Van Norman said. Installation of the third unit at power plant No. 2 will provide 20,000 hp. additional generating capacity on the city system. With the completion of the enlargement of Chatsworth reservoir with a few weeks, that storage basin will be increased 3,100 acre-ft., giving it a total capacity of 10,000 acre-ft. In addition to this, 6,500 acre-ft. has recently been added to lower San Fernando reservoir, giving it a capacity of 21,000 acre-feet.

A.S.M.E. Pure Air Body Announces Objectives

FORMAL DECLARATION of the policies and objectives of the A.S.M.E. Pure Air Committee was made public last week and those interested may obtain copies of the declaration by addressing the committee at headquarters of the American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

The Pure Air Committee was recently organized from the A.S.M.E. Fuels Division committee on smoke abatement and atmospheric pollution. One of the first projects of the new body will be to take action on the report of its sub-committee on setting heights of heating boilers. Members of this sub-committee are Elliott H. Whitlock, chairman; J. C. McCabe; H. K. Kugel and H. B. Meller.

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COMING CONVENTIONS

American Society of Mechanical Engineers. Annual meeting in New York City, Nov. 30-Dec. 4. Secretary, Calvin W. Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual winter convention in New York City, Jan. 25-29, 1932. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Society of Refrigerating Engineers. Joint meeting with the A.S.H.V.E. and annual convention at the Hotel Cleveland, Cleveland, Ohio, Jan. 26-29, 1932. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Water Works Association. Annual convention at the Hotel Peabody, Memphis, Tenn., May 2-6, 1932. Secretary, Beekman C. Little, 29 West 39th St., New York City.

Seventh Annual Conference on Welding, to be held by the Engineering Extension Department of Purdue University at Lafayette, Ind., Dec. 10-11. Professor in charge, W. A. Knapp, Engineering Extension Department, Purdue University, Lafayette, Ind.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Dr. H. C. Parmelee Made a Vice-President, McGraw-Hill

DR. HOWARD C. PARMELEE, editorial director of the McGraw-Hill Publishing Company, has recently been made a vice-president of the company, it was announced Nov. 10, by Malcolm Muir, president of the company.

Dr. Parmelee has been editorial director of the McGraw-Hill publications since 1928. Prior to that he was editor

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of *Chemical and Metallurgical Engineering,* from 1919 to 1928. He was graduated from the University of Nebraska in 1897 with the degree of Bachelor of Science, and later received the honorary degree of Doctor of Science from Colorado College.

For some years he was employed as a chemist by various firms around Denver, establishing his own consulting office there in 1902. He entered editorial work in 1905 as editor of the *Mining Reporter,* and joined the staff of *Chemical and Metallurgical Engineering* in 1910 as western editor. He was elected president of the Colorado School of Mines in 1916, and returned to his editorial activities with McGraw-Hill in 1917.

British Institute of Metals Announces Winter Program

THE INSTITUTE OF METALS has just issued its full program of meetings for the winter session both of the parent institute and of its six local sections in Birmingham, Glasgow, London, Newcastle-on-Tyne, Sheffield and Swansea.

Among the subjects dealt with are mechanical testing of metals, electric welding of non-ferrous alloys, the extrusion of metals, recent advances in rolling plant, X-ray examination of alloys, protective coatings on metals, and notes on condenser tubes.

Copies of the program can be obtained on application to the secretary, G. Shaw Scott, 36 Victoria St., Westminster, London, S.W.1, England.

Personals

WILLITS H. SAWYER, engineer of New York City, has been elected chairman of the executive committee of Iowa Public Service Company, Sioux City Gas & Electric Company and Sioux City Service Company, and will devote a portion of his time to active supervision in Iowa of these properties. He will continue his New York office, however, and also his consultant activities.

FRANK L. EIDMANN, professor of mechanical engineering at Columbia University, has been appointed director of the research and experimental laboratory of the General Time Instruments Corporation. Professor Eidmann will retain his university connection.

CHARLES G. MALEGARIE and GABRIEL DESSAU, of the Cie Parisienne de Distribution d'Electricité, and PHILIP BOULASSE, general technical secretary of the group, sailed for France on the Leviathan Nov. 7, ending a two-month tour of the United States and Canada. They came here in September with a group of twelve French engineers to visit the principle electric utility systems of North America. The rest of the party returned home several weeks ago.

FREDERICK W. DOOLITTLE, consulting engineer and vice-president of The North American Company, New York City, has been nominated for the executive committee of the Power Division of the American Society of Civil Engineers for 1932. Election of Mr. Doolittle will take place next month.

W. N. CLARK, vice-president and general manager of the Southern Colorado Power Company since 1924, has been elected president of the company to succeed JOHN J. O'BRIEN, who as president of the Byllesby Engineering & Management Corporation and Standard Gas & Electric Company has also served as president of most of the affiliated companies. Other elections in the Southern Colorado company include E. F. STONE as vice-president in charge of sales, M. G. LORD as vice-president in charge of operation and W. J. BENNING as vice-president and treasurer.

D. L. McLEAN, Hydro Electric Commissioner of Manitoba, has been appointed chairman of the recently formed Hydro Electric Commission of Manitoba. Other members of the new body are J. W. SANGER, chief engineer of the Winnipeg Hydro Electric Commission, and H. H. COTTINGHAM, chairman of the Winnipeg Parks Board.

RALPH B. WILLIAMSON, vice-chairman of the Federal Power Commission, is inspecting various power developments in the Pacific Northwest. His itinerary includes the Cushman project of the City of Tacoma, the Skagit River development of the City of Seattle and the Rock Island plant of the Puget Sound Power & Light Company.

How's Business?

EVIDENCES of actual increase in industrial and trade activity so far in November are still slight, scattered and of uncertain significance, according to *The Business Week*, Nov. 18. Resistance to seasonal decline of steel production, fairly well sustained strength in residential building and carloadings, an October upturn in department store sales, scattered increases in employment, and some recession in currency circulation after allowance for seasonal and price factors, are all encouraging indications, offset by persistent weakness in electric power output and check payments and continued bank credit liquidation.

Power production by public utilities for the week ended Nov. 7 was 1,628,147,000 kw-hr., or 5.8 per cent below the corresponding period last year, according to N.E.L.A. figures.

Business Notes

STEVENS & WOOD, INC., has been reorganized with offices at 120 Broadway, New York, N. Y. The reorganization follows the dissolution last month of Allied Engineers, Inc., which absorbed the original firm of Stevens & Wood in April, 1930. The new Stevens & Wood will follow the same line of design, construction and power plant engineering as the original concern.

GRINDLE FUEL EQUIPMENT COMPANY (subsidiary of the Whiting Corporation), Harvey, Ill., announces the appointment of C. F. Herington as sales engineer. Mr. Herington is well known in the combustion field and has had 28 years' experience in engineering work. He was formerly with Westinghouse, Church, Kerr & Company, and for the past fifteen years has had charge of engineering, sales and erection of pulverized-coal plants for Heyl & Patterson, Inc., Pittsburgh, Pa.

WARD-LOVE PUMP CORPORATION, Rockford, Ill., announces the removal of its Chicago office from 223 West Erie St. to Room 727 in the Chicago *Daily News* Building at 400 West Madison Street.

YOUNG RADIATOR COMPANY, Racine, Wis., reports much increased activity in its business during the past three months. In September and October day and night shifts have been run in the sheet-metal, stamping and assembly departments, the company states.

AMERICAN MANGANESE STEEL COMPANY, Chicago Heights, Ill., announces the removal of its Chicago office from 333 North Michigan Ave. to 1414 McCormick Building, 332 South Michigan Ave., where it will be located with the office of the parent company, American Brake Shoe & Foundry Company. It is also announced that E. R. Dougherty has joined the Amsco sales organization and will work with E. F. Mitchell, district manager of the Chicago territory.

GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., announces that Harry S. Sleicher, formerly vice-president of the North American Refractories Company, has severed his connection with that company and is now associated with General Refractories in a sales capacity, with headquarters at the New York office of the latter company.

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Trade Catalogs

BELT DRIVES — "Vim Short-Center Drives" is the title of a new 148-page belt treatise compiled by the engineering research staff of E. F. Houghton & Company, Philadelphia, Pa. Entirely new in treatment, the book contains charts, tables and engineering data on 5,000 standard "Vim" drives ranging from 5 to 100 hp. Distribution of this book is limited and copies will be delivered by a Houghton distributor to executives and engineers directly interested in power transmission.

METALS—Up-to-the-minute information on "Toncan" copper-molybdenum iron sheets is given in the newly revised, 64-page booklet (A.I.A. File No. 12a31) just issued by the Republic Steel Corporation, Youngstown, Ohio. Fully illustrated, the booklet describes various types of installations of this rust and corrosion resisting metal, and gives several examples of performance under unusually severe conditions.

GAS BURNERS—Bulletin No. 306, recently issued by the Denver Fire Clay Company, P. O. Box 1107, Denver, Colo., describes and illustrates the Type C atmospheric gas boiler burner. The bulletin includes engineering data on the construction, selection and operation of these units.

FLEXIBLE COUPLINGS—Specifications of Clark flexible couplings are given in an illustrated leaflet just issued by the Clark Coupling Company, 149 Church St., New York, N. Y. Three types are covered—heavy duty, medium duty and marine.

CONSULTING SERVICES — "The Consulting Chemist and Your Business" is the title of a booklet recently issued by Foster D. Snell, Inc., 130 Clinton St., Brooklyn, N. Y., which describes the consulting services of that firm. Among the services covered are research, product development, plant inspections, operation and management, chemical engineering, preparaton of surveys and legal testimony.

NEW PLANT CONSTRUCTION

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Claremont — Union Ice Co., awarded contract for pre-cooling plant, 8-car daily capacity to Gay Engineering Corp., 2650 Santa Fe Ave., Los Angeles.

Calif., Upland — Upland Citrus Association, preparing plans for a pre-cooling plant. $65,000. W. W. Ache, 1616 Fourht St., Los Angeles, is architect.

Idaho, Boise—U. S. Veterans Bureau, Washington, D. C., awarded contract for construction of outside steam distribution system to Lessinger Plumbing & Heating Co., Boise, and two 100 or 150 hp. boilers to Connor & Ripstra, 1015 East Douglas St., Wichita, Kan. $31,791.

Idaho, Coeur d'Alene — City plans election to vote $650,000 bonds for the construction of a municipal hydro-electric plant. Franklin R. Wood is engineer.

Ind., Newcastle—Epileptics Village, awarded contract for the construction of a new heating plant to Steinkamp Construction Co., Batesville. Estimated cost $50,000. Boiler setting, pipe fittings, etc., awarded.

Ky., Louisville — Quartermaster, Dept. Air Corps, c/o Major Spann, Jeffersonville, Ind., awarded contract for construction of airplane hangar with annex for boiler house here, to Thomas Harmon Engineering Co., 844 Rush St., Chicago, Ill. $61,207.

Mass., Gardner — Commonwealth of Massachusetst, Dept. of Mental Diseases, Boston, awarded contract for power generating plant at Gardner State Hospital here, to Proffit & White, 13 Oliver St., Fitchburg. $45,243. Boilers, boiler setting, coal handling and electrical equipment awarded.

Mass., Hingham—District Public Works, Navy Dept., Boston, will receive bids until November 20 for furnishing and installing complete air heating system including electric heater units, etc., at Naval Ammunition Depot, here.

Mass., Norfolk — Commonwealth of Massachusetts, Dept. of Correction, State House, will receive bids until November 25 for furnishing and erecting new boilers, stokers, forced draft equipment, coal and ash handling equipment at State Prison Colony.

Mass., Watertown—E. J. Sancomb, 33 Thaxter Road, Newtonville, is receiving bids for a 1 story laundry building, including boiler plant on Acton St., here. Estimated cost $40,000. W. Haines & Son, 32 Riverview Ave., Waltham, are architects.

Mass., Woburn—City awarded contract for alterations to waterworks pumping station at Horn Pond to John MacDonald Construction Co., 215 California St., Newton. Estimated cost $15,000.

Minn., Emmons—City awarded contract for the construction of an electric light and power plant including distribution system and 38 x 52 ft. power house, to M. O. Hylbak, Emmons. Estimated cost $90,000.

Minn., Kenyon—City awarded contract for the construction of a power house to Nietge Construction Co., Mankato, electrical distribution system to Minneapolis Electric Construction Co., 80 South 12th St., Minneapolis. Diesel engines and equipment to Worthington Pump & Machinery Corp., 1012 Pioneer Bldg., St. Paul. Estimated total cost $94,722.

Miss., Parchman—State Board of Trustees, Penal Farm, Jackson, will receive bids until November 18 for complete power plant at Parchman Penal Farm here. Estimated cost $70,000.

N. J., Jersey City — Mongiello Bros., 625 Communipaw Ave., having revised preliminary plans prepared for the construction of a 1 story, 100 x 100 ft. ice plant. Estimated cost $50,000. Christian Ziegler, 26 Journal Sq., is architect.

N. J., Wayne—Board of Chosen Freeholders, Court House, Paterson, will receive bids about December 1 for waterworks pumping station and piping at Valley View county grounds in connection with new water system. Estimated cost $50,000. Garwood Ferguson, Court House, Paterson, is engineer.

N. Y., Howard—Northern New York Utilities Corp., 58 Park Sq., Watertown, has been granted franchise for gas plant and main extensions here.

O., Eaton—City voted $250,000 bonds for construction of municipal electric light and power plant.

O., Lima—City will receive bids until December 1 (extended date) for a 4 story hospital, nurses' home, power plant and laundry building. Estimated cost $600,000. T. D. McLaughlin, Peter M. Hulskin and Lyman T. Strong, are architects.

Pa., Oil City—City awarded contract for general overhauling of high and low pressure pumps in connection with waterworks to National Transit Pump & Machinery Co., North Petroleum St., $15,000.

Pa., Pittsburgh — Press C. Dowler, Century Bldg., Archt., will receive bids until Nov. 24 for the construction of an 8 story hospital building including power house, etc., at South 20th and Jane Sts., for South Side Hospital. J. E. Roth, Pres., 6400 Beacon St. Estimated cost $2,000,000. S. S. Goldwater, 1212 5th Ave., New York, N. Y., is consulting architect.

Pa., Pittsburgh—U. S. Engineer's Office, War Dept., Washington, D. C., is receiving bids for the construction of a power house and administration building at Lock No. 4 on Mongahela River.

Pa., Pottstown—Hill School, J. T. Wendell, Headmaster, awarded contract for a 1 and 2 story, 53 x 134 ft. power house and laundry building, to F. H. Keiser, 128 East 4th St., Pottstown.

Tex., Borger—City, c/o J. R. Miller, Mayor, is receiving bids for the construction of a municipal power and light plant including generating station, distribution lines, etc., $45,000; also for gas system consisting of plant, distribution mains, etc., to supplant system now owned and operated by Pandhandle Power & Light Co.

Tex., San Antonio—City and Bexar County, plans a 4 story, 60 x 110 ft. additional unit to city and county hospital, including enlargement of heating plant at 515 Morales St. Estimated cost $150,000. Phelps & Oewees, 630 Gunter Bldg., are architects.

Tex., San Antonio—Treasury Dept., Washington, D. C., awarded fabricating and steel contracts for engineering shop and boiler house at Duncan Field. Estimated total cost $500,000.

Tex., Wellington—City will soon award contract for the construction of a natural gas system including booster plant, etc. Estimated cost $75,000. Private plans.

Ont., Haileybury—City plans a new water supply system including pump house, pumps, mains, etc., at Constance Lake. $20,000. J. F. Sumner is city engineer. James, Proctor & Redfern, 36 Toronto St., Toronto, are consulting engineers.

Que., Westmount—City plans considerable improvements and modernization of electric light department. $55,000.

Equipment Wanted

Pumps, etc.—Fresno, Calif.—D. M. Barnwell, County Clk., will receive bids until November 27 for a 100 g.p.m. deep well turbine pump against 120 ft. head and 100 g.p.m. booster pump against 1,200 ft. head with motor and complete equipment in connection with water system for Tubercular unit.

Pumps—San Luis Obispo, Calif.—San Luis Obispo County Water District No. 3, plans the installation of pumps, etc., in connection with waterworks. $18,000.

Pumping Units — Quincy (Boston P. O.), **Mass.**—Metropolitan District Commission, Sewerage Division, 20 Somerset St., Boston, will receive bids until November 25 for furnishing and erecting two vertical centrifugal electric driven pumping units including switchboard, etc., for Squantum pumping station, South Metropolitan sewage system.

Engines—Buffalo, N. Y—U. S. Engineer's Office, War Dept., Washington, D. C., will receive bids until November 20 for two complete Diesel engines and one 15 kw. generating set for U. S. Dredge "Taylor."

Pumps, Blowers, Motors, Switchboard, etc.—Newark, N. Y.—Village, D. F. Johnson, Chn. of Municipal Board, will receive bids until November 24 for installation of sludge pumps, blowers, electric motors, switchboard, gas engine, gas and coal burning hot water heaters, etc., in connection with reconstruction of existing sewage treatment plant.

Air Compressors, Pumps—Pittsburgh, Pa.—Dept. of Public Works, Edward G. Lang, will receive bids until November 20 for six portable driven air compressors, two 2 in. and one 4 in. gasoline driven centrifugal pumps and two double diaphragm, gasoline driven pumps, etc.

Reactors and Switchgear—Wellington, N. Z.—Dept. of Public Works, will receive bids until February 2 for 11,000 v. current limiting reactors and spares and 11,000 v. switchgear for Lake Coleridge power plant.

Transformers — Wellington, N. Z. — Thames Valley Electric Power Board, will receive bids until December 11 for supply of outdoor type static transformers.

Industrial Projects

Calif., Sanford—Owner, c/o W. C. Kirkpatrick, 124 West 4th St., Los Angeles, Engr., plans the construction of a dry ice plant.

Calif., San Gabriel—Eastern Airplane Mfg. Co., is having plans prepared for three buildings for ariplane factory. National Airport Engineering Co., 775 East Washington St., Los Angeles, is engineer.

Ill., Kankakee—Bear Brand Hosiery Co., 337 West Madison St., Chicago, awarded contract for a 3 story, 60 x 123 ft. factory on Washington St. to Immel Construction Co., 19 West Division St., Fond du Lac, Wis. $40,000.

Mass., Chelsea—Crescent Shoe Mfg. Co., 112 Crescent Ave., awarded contract for addition and alterations to factory to B. Steinberg Construction Co., 587 Putnam Ave., Cambridge. Estimated cost $40,000.

Mass., Everett (Boston P. O.) — Merrimac Chemical Co., J. B. Ruffer, Chemical Lane, awarded contract for a 1 story, 70 x 130 ft. H-acid plant to Tredennick-Billings Co., 10 High St., Boston. Estimated cost $40,000.

Mass., Westboro—Bay State Abrasive Products Co., O. S. Bucknam, Supt., will build a 2 story, 40 x 100 ft. addition to factory. Estimated cost $50,000. Private plans. Work will be done by owner's forces.

N. J., Bloomfield — General Electric Co., Lawrence St., revising plans for a 1 story addition to factory. Estimated cost $40,000. Private plans. Former bids rejected.

N. J., Elizabeth — I. Schonwalter, Meadow Lane, awarded contract for a 1 and 2 story tallow factory on Woodruff Lane to Drill Contracting Co., 60 Park Pl., Newark. Estimated cost $40,000.

O., West Lafayette—Moore Enameling Mfg. Co., plans a 1 story plant adjoining present plant, to be used for the manufacture of enameled kitchen utensils and will double capacity. Estimated cost $50,000. Private plans.

R. I., East Greenwich — Greenwich Mills, awarded conrtact for a 3 story, 75 x 94 ft. mill addition to O. D. Purington & Co., 49 Westminster St., Providence. Estimated cost $50,000.

Wis., Kaukauna—Thilmary Pulp & Paper Co., M. S. Wertheimer, Pres., awarded contract for a 2 story, 60 x 95 ft. plant and turbine room to Permanent Construction Co., 208 South LaSalle St., Chicago, Ill.

Wis., Wausau — Marathon Paper Mills Co., awarded contract for the construction of a paper mill to William Anderes, 412 First Ave.

Alberta, Calgary — Western Cartridge Company, Ltd., C. A. Voight, V. Pres., acquired a site and plans the construction of a factory for the manufacture of shot gun shells and small arms ammunition. Estimated cost $300,000.

Ont., Windsor—A. S. Boyle Co., plans construction of a plant for the manufacture of pharmaceutical supplies, cosmetics, etc., at College and Campbell Sts. Estimated cost $50,000. Electrically operated equipment will be required. Walker Whiteside, Bank of Commerce Bldg., in charge of building work.